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# RESEARCH REPORTS

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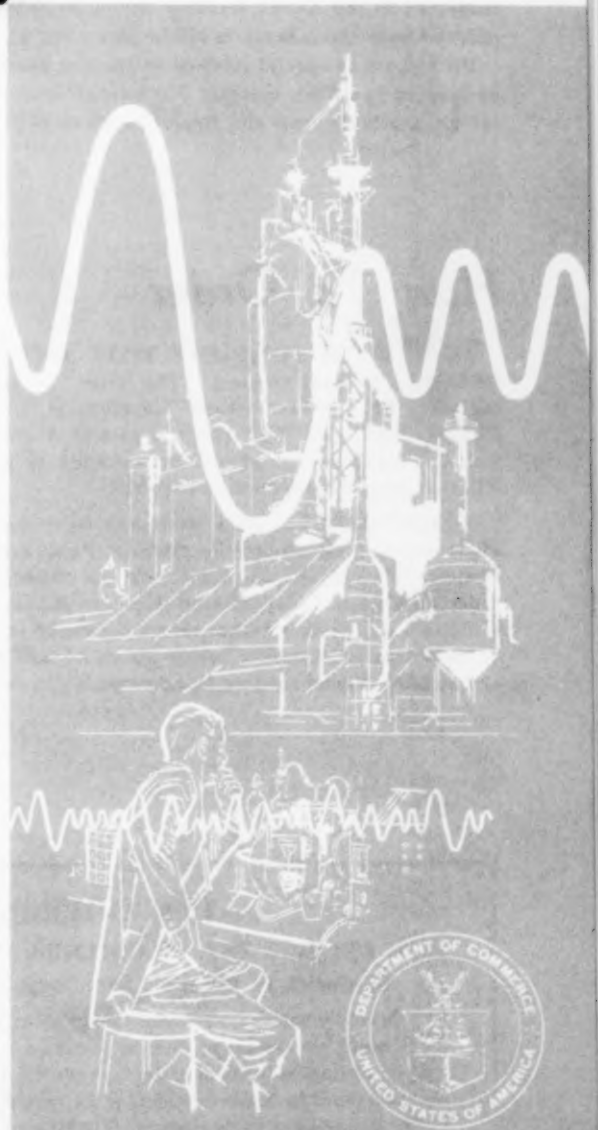

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OFFICE OF TECHNICAL SERVICES

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Office of Technical Services, Dept. of Commerce, Washington, D. C.
ARMED SERVICE TECHNICAL INFORMATION AGENCY-OFFICE OF TECHNICAL SERVICES CORRELATION INDEX OF TECHNICAL REPORTS (AD-PB REPORTS). Mar 58, 186p.
Order from OTS $3.00 PB 151 567S

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## AGRICULTURE

Bureau of Yards and Docks, Washington, D. C.
SOIL CONSERVATION. 1 Mar 53, 95p. 34 refs. Technical Pub. NAVDOCKS TP-Pw-5.
Order from OTS $2.25 PB 151 982

This publication deals with soil conservation and erosion control problems at naval shore activities. It establishes important criteria for the use of naval personnel concerned with the selection, preparation, and maintenance of construction sites, and the protection and care of lands and their soil and timber resources.

## ASTRONOMY

Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
THE PHOTOGRAPHIC EXPOSURE TIME FOR ASTRONOMICAL PICTURES, by Radames K. H. Gebel. Jan 59, 14p. 1 ref. WADC Technical note 59-54; AD-210 752.
Order from OTS $0.50 PB 151 939

An analysis is made of the factors affecting the photographic exposure time for celestial objects. The minimum number of quanta that must be received from a star, and the minimum number per unit solid angle that must be received from an extended source, to reach the photographic threshold, are determined, for the case when the camera is carried on an astronomical mount. The treatment is then extended to the case of a satellite, or other rapidly moving object near the earth, when the camera position is fixed with respect to the earth.

Ohio State U. Research Foundation, Columbus.
SOLAR SYSTEM RADIO RADIATION, by John D. Kraus. Scientific rept. no. 1-A on Contract AF 19(604)1591. Dec 58, 87p. 106 refs. AFCRC-TN-59-148; AD-211 944.
Order from LC mi$4.80, ph$13.80 PB 142 383

The present state of knowledge of radio radiation from sources in the solar system is summarized in four chapters on the sun, the moon, Jupiter, and the other planets. Thermal emission from the quiet sun is treated in relation to the Rayleigh-Jeans law. This is followed by sections on the slowly and rapidly varying components of radiation from the disturbed sun with a dynamic spectrum classification of the latter. Other solar topics include sunspot trends and solar noise power calculations. Thermal radio emission from the moon is discussed and moon radar observations are reviewed briefly. Observational data on the non-thermal radio emission from Jupiter are summarized and considered in terms of spectrum, rotation period, and radiated power. The last part of the report treats thermal radio radiation from the other planets.

### Astrophysics

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT AURORA, by W. A. Flood. Scientific rept.

no. 1 (Interim) on Contract AF 19(604)2454. 14 Oct 58, 30p. 10 refs. Rept. no. RM-1182-P-1; AFCRC-TN-58-653.
Order from LC mi$2.70, ph$4.80 PB 139 427

The results of simultaneous dual frequency radar observations of aurora during the Spring of 1958 are presented. The major point of interest to emerge from these observations is the fact that echoes at 226 mcs do not always appear at the same range as echoes at 50 mcs. The consequences of these observations in relation to presently available theories of auroral radar echoes are examined.

Georgetown Coll. Observatory [Washington, D. C.]
COMMENTS ON THE EPHEMERIDES AND CONSTANTS FOR A TOTAL ECLIPSE OF THE SUN, by Robert C. Cameron. Technical rept. no. 3 on Contract AF 19(604)880. May 58, 51p. 333 refs. GCO monograph no. 9; AFCRC-TN-58-602.
Order from LC mi$3.60, ph$9.30 PB 139 423

Corrections to the spheroidal coordinates of a site on the earth's surface or to the geodetic distance between two sites that have been deduced by comparing the observed circumstances of an eclipse with their predicted values are uncertain by an amount that depends on: (1) the uncertainties in the geodetic and astronomical constants, (2) the errors in the ephemerides used in the eclipse calculations, (3) the errors of timing the contacts, and (4) the errors that arise in referring the points of contact to an ideal spherical moon. The effect of these various sources of error on the final result (site coordinates or geodetic distances) is discussed.

High Altitude Observatory, Boulder, Colo.
VISITS TO SEVERAL EUROPEAN RADIO OBSERVATORIES, SUMMER, 1958, by James W. Warwick. Scientific rept. no. 2 on Contract AF 19(604)3872. 10 Dec 58, 28p. AFCRC TN-59-105; AD-208 330.
Order from LC mi$2.70, ph$4.80 PB 139 473

This report presents photographs and brief descriptions of some of the important equipment at the following four radio astronomical observatories: Paris Observatory (at Nancay); Heinrich Hertz Institute, East Berlin; Pulkova Observatory, near Leningrad; and the Crimean Astrophysical Observatory, on the north shore of the Black Sea. These descriptions are not intended to be exhaustive.

Maryland U., College Park.
DISTRIBUTION OF DENSITY IN A PLANETARY EXOSPHERE, by E. J. Opik and S. F. Singer. Rept. on Contract AF 19(604)3861. [1959] 10p. 1 ref. AFCRC-TN-59-437.
Order from LC mi$1.80, ph$1.80 PB 142 711

A theory has been developed which gives the distribution of density with altitude for a planetary exosphere in the absence of local thermodynamic equilibrium. The results differ considerably from those conventionally calculated on the basis of the hydrostatic equation.

Maryland U., College Park.
PROPERTIES OF THE UPPER ATMOSPHERE DEDUCED FROM THE RADIATION BELT, by S. F. Singer. Rept. on Contracts AF 49(638)530 and AF 19(604)5575. [1959] 23p. 17 refs. AFCRC-TN-59-386; AFOSR-TN-59-158; AD-211 117.
Order from LC mi$2.70, ph$4.80 PB 142 708

A new theory has been developed which gives the distribution of density with altitude for a planetary exosphere in the absence of thermodynamic equilibrium. The results differ considerably from those calculated on the basis of a hydrostatic equation.

Minnesota U., Minneapolis.
POSSIBLE EXPLANATION OF THE RADIATION OBSERVED BY VAN ALLEN AT HIGH ALTITUDES IN SATELLITES, by Paul J. Kellogg. Technical rept. on Cosmic Ray Program, Contract Nonr-710(19). Sep 58, 29p. 10 refs.
Order from LC mi$2.70, ph$4.80 PB 142 690

A possibility is considered that the radiation observed by Van Allen and co-workers at high altitudes is due to the decay electrons and protons from neutrons produced in the earth's atmosphere by cosmic rays and stored in the earth's magnetic field. Order of magnitude estimates for the densities to be expected are presented. Only scattering loss is considered.

Minnesota U., Minneapolis.
GEOMAGNETIC MEASUREMENTS OF HEAVY PRIMARY COSMIC RADIATION NEAR THE EQUATOR, by Robert E. Danielson. Technical rept. on Cosmic Ray Program, Contract Nonr-710(19). Sep 58, 53p. 18 refs.
Order from LC mi$3.60, ph$9.30 PB 142 692

The zenith and azimuthal angular distribution of primary cosmic radiation with charges $Z \geq 6$ has been measured near the equator (at Guam) using horizontal emulsions with known orientation relative to the earth.

## BEHAVIORAL SCIENCES

### Human Engineering

Aero Medical Lab. [Wright Air Development Center, Wright-Patterson AFB] Ohio.
A SURVEY OF PILOT PREFERENCE REGARDING KNOB SHAPES TO BE USED IN CODING AIRCRAFT CONTROLS, by Richard E. Jones. 28 Feb 47, 9p. 4 refs. Serial no. TSEAA-694-4E; ATI-111 140.
Order from LC mi$1.80, ph$1.80 PB 142 616

This survey was undertaken as a follow-up to findings reported in Memorandum Report TSEAA-694-4 in which 11 knob shapes were recommended as being satisfactory for recognition by touch alone. The purpose of the present study was to determine pilot preferences as to which aircraft controls should be coded and which of the 11 knobs should be used on different controls.

Aeronautical Medical Equipment Lab., Naval Air Material Center, Philadelphia, Pa.
A STUDY OF THE REQUIREMENTS FOR LETTERS, NUMBERS, AND MARKINGS TO BE USED ON TRANS-ILLUMINATED AIRCRAFT CONTROL PANELS. PART 4. LEGIBILITY OF UNIFORM STROKE CAPITAL LETTERS AS DETERMINED BY SIZE AND HEIGHT TO WIDTH RATIO AND AD COMPARED TO GARAMOND BOLD, by Fred R. Brown. 10 Mar 53, 28p. 5 refs. Rept. TED NAM EL-609, Part 4.
Order from LC mi$2.70, ph$4.80 PB 142 615

The experiments described in this report were designed to determine the effect of variations in size and in height-to-width ratio upon the legibility of capital block letters as they would be used on aircraft cockpit plastic lighting plates. In addition, a font of Garamond Bold capital letters characterized by variable height-to-width ratios, series, and non-uniform stroke-widths was used. Tests with letters differing in these form characteristics were conducted, using two exposure durations and five levels of red transillumination which simulated the conditions of night viewing of the plastic lighting plates. Using the same letter from variables, tests were conducted with simulated daylight illumination of two levels and employing a single duration of exposure. Recommendations are made for letters to be used on plastic lighting plates.

Aeronautical Medical Equipment Lab., Naval Air Material Center, Philadelphia, Pa.
A STUDY OF THE REQUIREMENTS FOR LETTERS, NUMBERS, AND MARKINGS TO BE USED ON TRANS-ILLUMINATED AIRCRAFT CONTROL PANELS. PART 5. THE COMPARATIVE LEGIBILITY OF THREE FONTS FOR NUMERALS, by William H. Atkinson, Lloyd M. Crumley, and Marion P. Willis. 13 June 52, 34p. 8 refs. Rept. TED no. NAM EL-609, Part 5.
Order from LC mi$3.00, ph$6.30 PB 142 614

The present experiment was designed to evaluate the legibility of the forms for numerals developed in this laboratory. These numeral forms are compared to the forms embodied in Air Force-Navy Drawing 10400 and the font developed by Berger. The tests were conducted under conditions of red transillumination ranging from .10 to 3.30 footlamberts and under conditions of daylight illumination with intensities of 11, 24 and 34 footcandles. For the transillumination tests the duration of the exposures was approximately 200 milliseconds, while in the daylight tests the duration of exposures was 5 milliseconds. The transillumination tests employed 30 subjects while the daylight tests required 48 subjects. As a result of this study, the digits of the AMEL proposed form are recommended for use in aircraft on plastic console panels. (See also PB 142 615)

Adjutant General's Office, Washington, D. C.
CONSTRUCTION OF THE OFFICER LEADERSHIP QUALIFICATION INVENTORY, OLI-1, by Jack A. Parrish, Walter A. Klieger, and June Loeffler. Rept. on Officer Procurement a-CO Proj. Nov 58, 20p. 7 refs. PRB Technical research note 100; AD-203 811.
Order from LC mi$2.40, ph$3.30 PB 139 385

The present study describes the development of the Officer Leadership Qualification Inventory, introduced operationally in November 1956 as part of the OCS selection battery. To obtain necessary data, previous operational and experimental self-description forms used for OCS selection were administered to 2637 officer candidates enrolled in 4 combat and 4 technical branch schools. Item-analysis techniques were employed to select the best item content for the new instrument from among multiple answer (background), preferred-choice, and yes-no types of items. Special items were included to help reduce distortion of scores arising from the tendency of some examinees to give "shaded" or untrue responses to test items. The new instrument was found to be more effective than the previous operational self description instruments for predicting success in OCS training.

Adjutant General's Office, Washington, D. C.
EVALUATION OF EXPERIMENTAL PREDICTORS FOR SELECTING ARMY HELICOPTER PILOT TRAINEES-I, by Joseph Zeidner, Harold Martinek, and Alan A. Anderson. Rept. on Helicopter a-31 Proj. Oct 58, 35p. 2 refs. PRB Technical research note 99; AD-202 033.
Order from LC mi$3.00, ph$6.30 PB 139 384

A long-range research approach to the problem of high attrition in the Army Cargo Helicopter Pilot course has consisted basically of studies to determine how well various experimental and operational instruments can improve selection for the course. The present study was undertaken to determine the effectiveness of the interim operational helicopter pilot selection battery in selecting successful trainees and to identify for further experimental use in a later large-scale study the most promising of 41 experimental measures tried out in the current study. Scores on the 41 measures, which included background data measures, ability and aptitude tests, personality, and leadership type measures, were obtained for 310 helicopter pilot trainees at Fort Rucker, Alabama entering a 22-week course of training between July 1955 and April 1956. Relation-

ships were obtained between scores on these measures and indexes of flying proficiency, academic achievement, and leadership proficiency. The more significant predictors, now to be considered for the long-range research effort, included such ability and aptitude tests as Two-Hand Coordination, Mechanical Aptitude, and Reaction to Signals for the prediction of flying proficiency. Previous flying experience was the best background factor for the prediction of flying proficiency. Military rank and elements of the OCB battery were the best predictors of leadership. The ACB tests plus Situational Reasoning and General Information were best for predicting academic achievement.

Human Resources Research Office, George Washington U., Washington, D. C.
A STUDY OF LEADERSHIP IN ARMY INFANTRY PLATOONS, by Carl J. Lange, Vincent Campbell and others (Army Leadership Human Research Unit) Research rept. 1 on Contract DA 44-109-qm-650. Nov 58, 61p. 39 refs.
Order from LC mi$3.90, ph$10.80 PB 142 579

The purpose of this study was to obtain information about the on-the-job leadership behaviors which distinguish between effective and ineffective infantry platoon leaders. Sources of data included (1) interviews with 281 platoon members to provide detailed descriptions of leader behaviors in specific situations, (2) a questionnaire administered to platoon members in which platoons and platoon leaders were rated on 15 items, (3) ratings by company commanders of platoon leaders on 23 items of leader effectiveness, (4) tests of intelligence and military information given to platoon leaders. Considerable agreement exists between subordinate and superior ratings. Many of the behavior variable scores derived from the data are related significantly to the criteria (subordinate and superior ratings); e. g., the effective leader clearly and consistently emphasizes performance as the basis of reward and punishment, uses punishment instructively and for motivational failures, and communicates clearly about the standards desired, providing precise information about needed improvement when reacting to below-standard performance.

Institute of Educational Research, Indiana U., Bloomington.
A REVIEW OF TROUBLE SHOOTING RESEARCH, by L. S. Standlee, W. J. Popham and N. A. Fattu. Research rept. no. 3 on Contract Nonr-908(07). Dec 56, 129p. 110 refs.
Order from LC mi$6.30, ph$19.80 PB 142 441

The purpose of the present report is to bring together into one source, in the form of an annotated bibliography, the publications regarding electronic trouble shooting.

Connecticut U., Storrs.
ASSOCIATIVE CLUSTERING IN THE RECALL OF MINIMALLY MEANINGFUL GEOMETRIC DESIGNS, by W. A. Bousfield, H. Berkowitz and G. A. Whitmarsh. Technical rept. no. 28 on Contract Nonr-631(00). Aug 58, 8p. 6 refs.
Order from LC mi$1.80, ph$1.80 PB 142 824

Psychological Lab., U. of Southern California, Los Angeles.
THE RELATIONS OF CREATIVE-THINKING APTITUDES TO NON-APTITUDE PERSONALITY TRAITS, by J. P. Guilford, P. R. Christensen and others. Rept. on Studies of Aptitudes of High-Level Personnel, Contract N6onr-23810. Dec 57, 51p.
Order from LC mi$3.60, ph$9.30 PB 142 439

This report concerns a group of analyses relating certain motivation and temperament factors to certain aptitude factors in the intellectual area. The study represents an extension of the comprehensive program of studies being carried out for investigating abilities that are considered important in the successful performance of high-level personnel.

Willow Run Labs., U. of Michigan, Ann Arbor.
AN EXPERIMENTAL STUDY OF THE NATURE OF FORCED-CHOICE RESPONSES IN VISUAL DETECTION, by W. M. Kincaid and C. E. Hamilton. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Jan 59, 28p. 13 refs. Rept. no. 2144-295-T.
Order from LC mi$2.70, ph$4.80 PB 142 785

Several hypotheses about the nature of forced-choice responses in visual detection were examined and their predictions tested. It was concluded (1) that the observer's response involves a comparison of sensory impressions from different presentation intervals on some, but probably not all, presentations; and (2) that the relation between $\Delta B$ (the added luminance of the target area) and the neural concomitants of response is basically nonlinear.

Willow Run Labs., U. of Michigan, Ann Arbor.
METHODOLOGICAL STUDIES OF THE TEMPORAL FORCED-CHOICE EXPERIMENTAL TECHNIQUES, by W. M. Kincaid and C. E. Hamilton. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Feb 59, 23p. 9 refs. Rept. no. 2144-317-T.
Order from LC mi$2.70, ph$4.80 PB 142 786

A set of experiments investigating the influence on performance in a visual detection experiment of information given observers about the relative detectability of targets provided a basis for making a distinction between informational and motivational differences in performance. The results suggest that any differences in performance are motivational in nature. Experiments using the temporal forced-choice procedure were also conducted to find out whether the probability

of detection was affected by the serial position of the target interval. For two of the three observers tested, differences were found which appeared to be due to a tendency to select response intervals adjacent to the actual target interval.

Willow Run Labs., U. of Michigan, Ann Arbor.
MONOCULAR AND BINOCULAR DETECTION THRESHOLDS FOR TARGETS VARYING IN SIZE AND RETINAL POSITION, by Alfred B. Kristofferson. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 18p. 13 refs. Rept. no. 2144-290-T.
Order from LC mi$2.40, ph$3.30 PB 142 784

Detection probabilities, determined by the temporal forced-choice method, are presented for targets of several diameters between 2 and 64 minutes, for binocular and monocular target presentation. In the experiments of Series I, the target was presented 20 degrees peripherally at zero background luminance. For Series II, the background luminance was approximately 10 foot-lamberts and target presentation was foveal. The ratio of binocular to monocular threshold luminances is 1.61 for Series I, and 1.46 for Series II, and is unrelated to target area in each case. The extent of binocular summation is greater than that expected, if the eyes are considered to be independent probability mechanisms, and is estimated to approximately its true amount by the assumption that sensory excitation increases as the square of target luminance, and adds algebraically between the two eyes. The extent of binocular summation is independent of target size.

Willow Run Labs., U. of Michigan, Ann Arbor.
THEORETICAL MODELS FOR THE DISCRIMINATORY PROCESS IN VISUAL DETECTION, by W. M. Kincaid. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Jan 59, 15p. 8 refs. Rept. no. 2144-281-T.
Order from LC mi$2.40, ph$3.30 PB 142 750

A variety of theoretical models for the discriminatory process involved in visual detection under laboratory conditions have previously been proposed, ranging from simple threshold notions to theories of signal detection in the presence of noise. These models may be shown to represent variants of more general model, which is expressed in terms of an abstract space corresponding with the set of possible states of the central nervous system. Different subsets of this space correspond to different responses. Each stimulus presented generates a probability distribution on the space. This formulation clarifies certain issues and suggests possible avenues of future research.

## BIOLOGICAL SCIENCES

Coastal Studies Inst., Louisiana State U., Baton Rouge.
BOTANICAL RECONNAISSANCE OF THE OUTER BANKS OF NORTH CAROLINA, by Clair A. Brown. Technical rept. no. 8, Pt. C. on Contract N7onr-35608. 1 Dec 57, 185p. 41 refs.
Order from LC mi$8.40, ph$28.80 PB 142 474

The major habitats of the Outer Banks are (1) dunes, both grass covered and wooded; (2) sand flats; and (3) salt marshes. Each of these has a characteristic vegetation. The sand fencing has been very effective in establishing barrier dunes along the beach. Grasses, planted in connection with the dune construction, have stilled much of the shifting sand. The most important grasses used on this project were American beachgrass, sea oats, saltmeadow cordgrass, and Bermuda grass. Some of the tree planting has been injured at times by the salt spray. The best trees and shrubs in use in this area are live oak, yaupon, wax myrtles, silverling, and marsh elder. Maritime pine, a native of the Mediterranean region, was used in limited quantities. It proved to be more resistant to the salt spray than the native pines and should have a wider use. This survey established that there are several additional native plants of primary value and more of secondary value in sand fixation. Some of these are knotgrass, running beach-grass, silver beachgrass, sea-shore elder, gallberry, silverling, and beach heather.

Franklin Inst. Labs. for Research and Development [Philadelphia, Pa.]
SURVEY OF REACTOR FACILITIES FOR RADIATION BIOLOGY RESEARCH, by Musa Halev. Rept. on Contract N62269-192. 22 Oct 58, 186p. 352 refs. Rept. no. 1 on Proj. NM 19 03 12.2; NADC-MA-5813.
Order from LC mi$8.40, ph$28.80 PB 142 529

A comprehensive survey of unclassified literature was made regarding the application of nuclear reactors to biological research. The properties of reactor radiation are summarized. Principal attention is directed to techniques for modifying this radiation for biological experiments. The relative advantages of reactors as compared with other radiation sources are recapitulated. Safety, the effects of experiments on reactivity, and other reactor operating problems are discussed, as also are the costs and operating expenses of various types of installations. Reactor experimental facilities are described, with particular emphasis on biological experimental irradiation facilities. All known reactors being constructed or planned primarily for medical purposes are described. Appendices include a very extensive bibliography and a survey questionnaire, "Radiation Biology Research", previously issued as a separate document. In the survey, nearly all laboratories having experience in the field of radiation biology research replied to questions relating mainly to the application of nuclear radiation in their own researches.

Illinois U. Coll. of Medicine, Chicago.
EVALUATION OF ATROPINIZATION BY VARIOUS ROUTES IN HUMANS, by Philip Andrews, Robert D. Miller, and Archer S. Gordon. Semi-annual progress rept. on Contract DA 18-108-cml-5365. July 55, 17p. 17 refs. MLCR no. 59.
Order from LC mi$2.40, ph$3.30 PB 142 505

Subcutaneous and intramuscular injection and inhalation of powder and nebulized solution were studied.

New York U. Coll. of Engineering, N. Y.
SKIN EXCRETIONS, by William T. Ingram. Rept. on Engineering Biotechnology of Handling Wastes Resulting from a Closed Ecological System, Contract AF 18(603)71. Oct 57, 7p. 8 refs. AFOSR TN-58-260; AD-154 171.
Order from LC mi$1.80, ph$1.80 PB 139 310

A review of the chemical composition of sweat offers a range of values. The components are summarized.

## Anatomy and Physiology

Aero Medical Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
ANIMAL AND HUMAN STUDIES OF THE EFFECTS OF LOW-FREQUENCY OSCILLATION COMBINED WITH TRANSVERSE ACCELERATION, by Mitchell B. Riley and Albert T. Bernardini. Rept. on Biophysics of Space Flight. Mar 59, 13p. 9 refs. WADC Technical note-59-92.
Order from OTS $0.50 PB 151 941

Animal and human endurance is reported to low-frequency oscillation combined with acceleration having a resultant force acting in the back-to-chest direction. No significant suggestion of trauma was found in animals subjected to a maximum oscillation-g pattern of 2.8 cycles per second through a 36° arc in a 12 g field. In humans, there was no identifiable endpoint when they were subjected to a maximum oscillation-g pattern of 0.7 cycle per second through a 36° arc in an 8 g field.

Air Force Missile Development Center, Holloman AFB, N. Mex.
FLIGHT EXPERIMENTS ABOUT HUMAN REACTIONS TO ACCELERATIONS WHICH ARE FOLLOWED OR PRECEDED BY THE WEIGHTLESS STATE, by Harold J. von Beckh. Dec 58, 48p. 22 refs. AFMDC TN-58-15; AD-154 108.
Order from LC mi$3.30, ph$7.80 PB 142 561

Flight experiments conducted in jet aircraft simulated "Pre-weightlessness" and "Post-weightlessness" accelerations. It was shown that alternations of acceleration and the weightless state decrease the acceleration tolerance of the subject and the efficiency of the physiological recovery mechanisms. The implications for planning of manned space flight are, first, thrust values and re-entry profiles must take the lower accerleration-tolerance into consideration; and second, that adequate g-protection must be designed for the pilot, to prevent dangerous effects of unavoidable high accelerations.

Aviation Medical Lab., Naval Air Development Center, Johnsville, Pa.
SOME EFFECTS OF ACCELERATION ON HUMAN SUBJECTS, by M. G. Webb. Rept. no. 1 on Project NM 11 02 12.5. 30 Sep 58, 11p. 11 refs. NADC MA-5812.
Order from LC mi$2.40, ph$3.30 PB 139 416

The results of the stress of acceleration on the cardiovascular system, the central nervous system, and certain nonspecific areas are described. Several possible long-term effects, as well as some specific suggestions for protection against, and prevention of these effects are presented.

Scuola di Perfezionamento in Fisica Teorica e Nucleare, Sezione di Cibernetica, Naples (Italy).
THE CEREBELLAR CORTEX AS A TIMING ORGAN. DISCUSSION OF A HYPOTHESIS, by V. Braitenberg and N. Onesto. Technical note no. 2 on Contract AF 61(052)96. Jan 59, 18p. 10 refs. AFOSR TN-59-471; AD-215 230.
Order from LC mi$2.40, ph$3.30 PB 142 482

Morphological evidence led to the assumption that the cerebellar cortex is timing organ, a nerve not in which the precise timing of successions of impulses plays an important role. A study of the histology of the parallel fibers and the Purkinje cell system, translated into physiological and neurological language supporting the importance of the cerebellar cortex in rapid voluntary movements, is presented.

University Hospitals, Iowa City.
HARMONIC DISTORTION IN COCHLEAR MODELS, by Jurgen Tonndorf. Nov 58, 15p. 16 refs. AFSAM rept. no. 58-122.
Order from LC mi$2.40, ph$3.30 PB 142 537

According to Bekesy, the envelope over the train of waves traveling along the cochlear partition is asymmetrical; the distal slope being steeper than the proximal one. In experiments on cochlear models, this asymmetry was seen to increase with intensity. Introduction of artificial "eddies" of varying velocity into the model (while the intensity was kept constant) indicated that the "eddies" were responsible for the observed increase in asymmetry of the envelope. Theoretic considerations show that the "eddies" convert the (trochoidal) particle motion within the cochlear fluids into a cycloid form of motion. The bilateral effects of this particular cycloid motion lead to the following alteration of the displacement pattern of the cochlear partition: (1) to an amplitude decrement with distance (accounting for the above asymmetry of the envelope); (2) to peak clipping; and (3) to an asymmetry, the displacement being larger toward the tympanic than toward the vestibular scala. These theoretic results were confirmed by an observed change of the particle orbits. Their elliptical shape became "flattened," containing both odd and even harmonics. Resolution of this distorted pattern of fluid motion along the cochlear partition was in accordance with the place principle of frequency localization.

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL ACUITY FOR CIRCULAR AREA LINE-GRATINGS PRESENTED AT VARIOUS INCLINATIONS IN THE VISUAL FIELD, by E. Rae Harcum and H. R. Blackwell. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Sep 58, 13p. 10 refs. Rept. no. 2144-318-T.
Order from LC mi$2.40, ph$3.30 PB 142 788

Visual acuity was measured in the frontal plane of the visual field, utilizing a grating consisting of black and white bars at four inclinations. Measurements were made both with a sharp-edged circular aperture limiting the grating visible to the observers, and with a photographic transparency which produced a graduated rather than a sharp edge for the target pattern. It was found that significantly more errors were made in recognition of the orientation of the grating with the Graduated-Edge than with the Sharp-Edge mask. Errors were found to be least for the vertical and horizontal inclinations, and greatest for the two diagonal inclinations. These results were the same with each mask, so that no evidence was found that "edge-cues" influence the pattern of errors made at various inclinations.

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. II. NINE-ELEMENT TYPEWRITTEN TARGETS, by E. Rae Harcum. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Dec 58, 27p. 43 refs. Rept. no. 2144-293-T.
Order from LC mi$2.70, ph$4.80 PB 142 780

Nine target elements, each composed of typewritten zeros with or without a crosshatch, were presented tachistoscopically in arrays at inclinations of 0, 45, 90, and 135 degrees to the horizontal in the visual field. The point of fixation registered with center element in each target, located 24 inches from the observers' eyes. There was a small constant increase in the total number of errors in pattern reproduction as the target was rotated from horizontal through 45, 90 and 135 degrees. The fewest errors appeared at the left or upper-left in the visual field and most errors appeared at the right or lower-right of fixation for both observer groups and for both observing conditions.

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. III. PATTERNS OF BLACKENED CIRCLES IN AN EIGHT-CIRCLE TEMPLATE, by E. Rae Harcum and Ausma Rabe. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 77p. 31 refs. Rept. no. 2144-294-T.
Order from LC mi$4.50, ph$12.30 PB 142 779

This report contains the results of an experiment investigating the ability of human observers to reproduce complex binary target patterns presented to them tachistoscopically at various locations in the visual field. Linear arrays of blackened or open circles were presented at 0°, 45°, 90°, or 135° to the horizontal about the center of fixation in the frontal plane. For target elements of the size and separation from fixation of those used in these experiments, presented for about 0.075 seconds, the reproduction capability is generally best to the left and right of fixation, and worst above and below fixation. (See also PB 142 780)

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. IV. LINEAR BINARY PATTERNS AT THIRTY-SIX ORIENTATIONS, by E. R. Harcum and A. Rabe. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 43p. 9 refs. Rept. no. 2144-296-T.
Order from LC mi$3.30, ph$7.80 PB 142 778

This experiment tested the recognition capacity of human observers for linear binary targets presented tachistoscopically at various locations in the visual field. For targets whose centers register with the fixation point, vertical arrays resulted in most errors of reproduction and horizontal patterns produced least errors. Errors of pattern reproduction were generally most frequent when the target appeared along a hypothetical line through the fixation point, and least frequent when the target appeared perpendicular to that line. There was a slight disadvantage for targets appearing in the upper half of the visual field. Generally, there were less errors in areas near the fixation point. The target arrays in this experiment appeared at angles of 0°, 45°, 90°, or 135° to the horizontal and at nine eccentric locations relative to fixation. The observers were required to produce the inclination of the target array and the pattern of binary elements.

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. V. BINARY PATTERNS ALONG 12 MERIDIANS, by E. Rae Harcum. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 23p. 6 refs. Rept. no. 2144-302-T.
Order from LC mi$2.70, ph$4.80 PB 142 777

This report contains the results of an investigation of human capability to reproduce linear binary patterns presented tachistoscopically at inclinations in 15° steps from horizontal about the visual field. Eight-element targets of open and blackened circles were used, with four elements appearing on either side of fixation. The observers were required to reproduce the target patterns. Generally, fewer errors of pattern reproduction were found in the left visual field than in the right field. The greatest difference in number of errors on opposite sides of fixation appeared at about horizontal inclinations of the targets. (See also PB 142 778)

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. VI. 8-ELEMENT AND 10-ELEMENT BINARY PATTERNS, by E. Rae Harcum. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 22p. 7 refs. Rept. no. 2144-303-T.
Order from LC mi$2.70, ph$4.80 PB 142 776

This report describes the recognition capacity of human observers for linear binary patterns presented tachistoscopically at inclinations of 0, 45, 90 and 135 degrees in the visual field; 8-element and 10-element targets were used, with half of the elements falling on each side of fixation. The observers were instructed to reproduce the pattern of elements. For both 8-element and 10-element targets least errors are found for horizontal targets and most errors appear for vertical targets. Generally, fewer errors are found at the left of fixation than on the right of fixation. This difference is slightly greater for 10-element targets than for 8-element targets.

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. VII. EFFECT OF TARGET LENGTH MEASURED IN ANGULAR UNITS, by E. Rae Harcum. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 26p. 7 refs. Rept. no. 2144-304-T.
Order from LC mi$2.70, ph$4.80 PB 142 753

This report describes an investigation of human recognition capacity for linear binary target patterns presented tachistoscopically in the frontal plane of the visual field, at inclinations of 0, 45, 90 and 135 degrees along hypothetical lines passing through the center of fixation. The observers were required to reproduce the target pattern under experimental conditions designed to assess the importance of the angular length of the target, the exposure duration, and the location of the target on one side of fixation or another, or registered at its center with fixation. The results indicate that, for the values investigated, angular length and exposure duration of the targets are not crucial to the results. However, whether the target is eccentric to fixation or bisected by fixation is an important factor in determining the relative recognition capability for right and left halves of the visual field. (See also PB 142 776)

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. VIII. PATTERNS OF SOLID CIRCLES AND SQUARES, by E. R. Harcum and A. Rabe. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Dec 58, 29p. 25 refs. Rept. no. 2144-306-T.
Order from LC mi$2.70, ph$4.80 PB 142 752

This report contains the results of an investigation of human capacity for reproducing binary patterns of squares and circles, presented at various locations in the frontal plane of the visual field. Linear arrays of square and circular elements, which passed through the point of fixation at angles of 0, 45, 90, and 135 degrees to the horizontal, were presented at two tachistoscopic exposure durations both to practiced and to unpracticed observers. For both exposure durations and for both groups of observers the reproduction accuracy was greatest for target elements to the right and left horizontally from fixation, and worst vertically above and below fixation. (See also PB 142 753)

Willow Run Labs., U. of Michigan, Ann Arbor.
VISUAL RECOGNITION ALONG VARIOUS MERIDIANS OF THE VISUAL FIELD. IX. MONOCULAR AND BINOCULAR RECOGNITION OF PATTERNS OF SQUARES AND CIRCLES, by E. Rae Harcum. Rept. on Proj. Michigan, Contract DA 36-039-sc-52654. Nov 58, 25p. 7 refs. Rept. no. 2144-307-T.
Order from LC mi$2.70, ph$4.80 PB 142 787

This report contains the results of an investigation of human pattern reproduction capacity for linear binary targets presented tachistoscopically along various meridians of the frontal plane of the visual field. Eight-element targets composed of squares and circles were presented at inclinations to the horizontal of 0, 45, 90, and 135 degrees such that four elements appeared on either side of fixation. The observers were required to reproduce the target patterns when viewing was restricted to the right eye or left eye, and when viewing was binocular. Fewest errors of reproduction appeared for horizontal targets and most errors appeared for vertical targets. The numbers of errors for target elements on opposite sides of fixation were not materially affected by which eye was used for observing. (See also PB 142 752)

## Microbiology

National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.
AN INVERTOR RACK FOR SIMULTANEOUS AND UNIFORM RESUSPENSIONS, by Jack C. Jenkins. [1959] 5p.
Order from LC mi$1.80, ph$1.80 PB 142 858

A rack designed for a series of test tubes used in one test where it is necessary to resuspend the solution therein simultaneously and uniformly, at the same time keeping out contamination from one tube to another by means of a parafilm or saran wrap seal when pressure is applied. The seal can be discarded after each use. This rack makes it possible to obtain the greatest possible precision in reading the results.

Naval Research Lab., Washington, D. C.
ELECTROPHORETIC PROPERTIES OF SPORES OF ASPERGILLUS NIGER, by P. J. Hannan. 11 Aug 59, 18p. 16 refs. NRL rept. 5354.
Order from OTS $0.50 PB 151 798

A microelectrophoresis apparatus has been constructed for the purpose of studying the surface properties of fungus spores. The advantages and disadvantages of this apparatus in particular, and of the electrophoresis technique as a whole, are discussed. The surface of Aspergillus niger spores was studied in some detail. There may be many surface components but the predominant characteristic is that of a polysaccharide, probably a starch since the mobility of the spores changes after treatment with takadiastase, a starch-hydrolyzing enzyme. Also, the surface appears to contain an acid group which is readily neutralized and a group which is easily hydrolyzed by dilute alkali.

## Pathology

Naval Medical Research Inst., Bethesda, Md.
STUDIES ON PATHOGENESIS AND IMMUNITY IN LYMPHOCYTIC CHORIOMENINGITIS INFECTION OF THE MOUSE, by Wallace P. Rowe. Vol. 12, p. 167-220. 27 May 54, 53p. 71 refs. Research rept. on Project NM 005 048. 14.01.
Order from LC mi$3.60, ph$9.30 PB 142 674

A study of pathogenesis and acquired immunity in lymphocytic choriomeningitis (LCM) infection of adult mice has been carried out, with emphasis on determin-

ing the relation between virus growth and development of disease and developing procedures for demonstrating protective antibodies in immune mice. Evidence has been obtained that the degree of reactivity of the host to the growth of high titer virus is an important factor in the pathogenesis of the disease and in acquired immunity, and that the reactivity is modified by previous infection, persistence of virus in the host, X-irradiation, and possibly by immune mouse serum. A sensitive intraperitoneal protection test has been developed which for the first time demonstrates the presence of protective antibody in immune mice. The interference phenomenon has been demonstrated between LCM strains differing in intraperitoneal pathogenicity.

School of Aviation Medicine, Randolph AFB, Tex.
THE ROLE OF THE ALTITUDE CHAMBER IN THE DIAGNOSIS AND DISPOSITION OF PROBLEM AEROMEDICAL CASES, by Charles A. Berry and Arthur Arthur H. King. Nov 58, 21p. 8 refs. Aeromedical Reviews no. 7-58.
Order from LC mi$2.70, ph$4.80 PB 142 538

The use of the altitude (low-pressure) chamber as a diagnostic tool in problem aeromedical cases was discussed. It provides a controlled altitude environment at ground level, thus providing greater safety and easier monitoring. Each "flight" must be tailored to the individual case and should closely simulate the actual conditions surrounding the referral incident. Case histories of consultation cases from the School of Aviation Medicine have been presented. The chamber was an aid to diagnosis in the following types of cases: ENT problems, cardiac problems, pulmonary problems, hypoxia, hyperventilation, and head injuries.

Yale U. [New Haven, Conn.]
TRANSMISSION AND EPIDEMIOLOGY OF TOXOPLASMOSIS, by David Weinman. Final rept. on Contract Nonr-1148(00). [1957] 6p. 7 refs.
Order from LC mi$1.80, ph$1.80 PB 142 440

Conclusions, which relate to the major epidemiological problems summarized as follows. "We have found that (1) pigs may become infected by cannibalism or by feeding on infected rodents; (2) there is strong evidence that pigs in nature are Toxoplasma carriers; (3) Toxoplasma organisms in the living pig may be expected to be viable when the pork cuts arrive in the kitchen; (4) Toxoplasma in tissue survives the attack of gastric digestion for a period equal to the average stay in the human stomach; (5) primates can be infected by the oral route; and (6) humans who eat undercooked pork are more likely to have toxoplasmic serums with high titers than the normal population.... We.... feel.... that we have accumulated very suggestive evidence incriminating one definite specific transmitting mechanism. This may even prove to be one of the important means whereby toxoplasmosis is contracted."

# CHEMISTRY

## Analytical Chemistry

Lockheed Aircraft Corp., Sunnyvale, Calif.
AN EVALUATION OF TECHNIQUES FOR THE ANALYSIS OF OXYGEN IN BERYLLIUM, by Wanda G. Bradshaw. Rept. on Contract NOrd-17017. 14 Mar 58, 43p. 57 refs. LMSD-2312.
Order from LC mi$3.30, ph$7.80 PB 142 758

A survey of possible methods of analyzing for oxygen in beryllium was made and the principles of the various methods are described. Where available, numerical results obtained by various methods and by different laboratories are compared. The advantages of the possible methods and their probable sources of error are discussed. Finally, on the basis of these studies, recommendations for the most reliable methods and those showing greatest promise for trace analysis are made.

Materials Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
RAPID SEPARATION AND GRAVIMETRIC DETERMINATION OF ALUMINUM IN FERROUS METALS, by Lois A. Keyser and Charles D. Houston. Rept. for Oct 57-Aug 58 on Materials Analysis and Evaluation Techniques. May 59, 12p. 11 refs. WADC Technical note 58-361; AD-214 695.
Order from OTS $0.50 PB 161 003

A rapid method separating iron and aluminum has been developed, with the aluminum being determined gravimetrically. It is applicable to analyzing for aluminum in ferrous metals in the absence of nickel. The separation of iron and aluminum is accomplished via the sodium hydroxide method, and the aluminum is precipitated with 8-hydroxyquinoline.

Pitman-Dunn Labs., Frankford Arsenal, Philadelphia, Pa.
DETERMINATION OF CHLORINATED RUBBER AND POLYVINYL CHLORIDE IN THE PRESENCE OF EACH OTHER, by G. Norwitz. 25 Mar 58, 15p. 39 refs. Technical rept. no. S-5732; AD-200 096.
Order from LC mi$2.40, ph$3.30 PB 142 772

Various aspects of the analytical chemistry of chlorinated rubber and polyvinyl chloride were considered in developing a procedure for the determination of these substances in the presence of each other. A method is proposed whereby the chlorinated rubber is separated from the polyvinyl chloride by the use of chloroform which dissolves the chlorinated rubber but not the polyvinyl chloride. The chlorine content of the chlorinated rubber and polyvinyl chloride is then determined by a new procedure which involves a closed fusion system. In this procedure the sample is mixed with sodium carbonate in a large platinum crucible, a smaller crucible is inserted upside down into the large

crucible, and the space between the two crucibles is packed with magnesium oxide. On heating, the sodium carbonate melts but the magnesium oxide does not. The sodium carbonate and magnesium oxide are dissolved in nitric acid and chlorine determined as silver chloride.

Purdue U. [Lafayette, Ind.]
A SYSTEM FOR THE ANALYSIS OF NITRATES AND OXIDES OF NITROGEN, by F. Vratny. Rept. on Contract AF 18(603)45. May 59, 12p. 2 refs. AFOSR TN-59-602; AD-217 175.
Order from LC mi$2.40, ph$3.30 PB 142 733

A system for the analysis of oxides of nitrogen and metal nitrates is presented. The factors affecting the analysis are tested by analyses of $NO_2$, and various nitrates.

## Inorganic Chemistry

Houston U., Tex.
THE BORON BASES, by George W. Campbell, Jr. and Louis A. Martincheck. Final technical rept. for 1 Nov 53-31 Jan 57 on Contract DA 23-072-ORD-964. 1 Feb 57, 41p. 14 refs.
Order from LC mi$3.30, ph$7.80 PB 142 684

The primary interest of this project has been the preparation and properties of the boron bases, typified by the compound $Na_2HB(CH_3)_2$. The preparation of the dimethylborohydrides of calcium and lithium have been accomplished. Another issue has been the investigation of the ammoniate of tetramethyldiborane.

Naval Ordnance Test Station, China Lake, Calif.
SOME INORGANIC REACTIONS OF THE OXYCHLORIDES OF NITROGEN, by Herman F. Cordes and Neil R. Fetter. 3 Mar 58, 15p. 18 refs. NOTS-1898; NAVORD rept. 5818.
Order from LC mi$2.40, ph$3.30 PB 139 302

Experimental results of attempts to prepare nitronium perchlorate, nitronium azide, nitrosonium fluosulfonate, and pernitric acid from nitryl and nitrosyl chloride are presented in this report. Nitronium perchlorate was prepared from nitryl chloride and anhydrous perchloric acid and nitrosonium fluosulfonate was made from nitrosyl chloride and fluosulfonic acid. Attempts to prepare nitronium azide from sodium azide and nitryl chloride, sodium azide and nitronium fluosulfonate, and hydrazoic acid and nitryl chloride failed. The preparation of pernitric acid from nitryl chloride failed. The preparation of pernitric acid from nitryl chloride and concentrated hydrogen peroxide were hampered by the side reaction of chloride ion with peroxide and peracids. Analytical data on nitronium perchlorate and nitrosonium fluosulfonate are presented in the appendix.

North Carolina U., Chapel Hill.
ADDITION COMPOUNDS OF METAL HALIDES WITH $POX_3$ COMPOUNDS, by J. C. Sheldon and S. Y. Tyree. Technical rept. no. 3 on Synthesis of New Organic Molecules, Contract Nonr-855(05). 1 Mar 58, 14p. 21 refs.
Order from LC mi$2.40, ph$3.30 PB 139 389

The P-O band in the infrared spectra of solid addition compounds between phosphoryl halides and metal halides is shown to shift to a lower frequency with respect to the pure phosphoryl halide. The shift is interpreted as suggesting that the bonding in the addition compounds is through oxygen. Triphenylphosphine oxide-metal halide addition compounds have been synthesized as models for comparison in which the bonding can be only through oxygen. Phase studies are reported for the systems $TiBr_4$-$PBr_3$, $POBr_3$-$SnBr_4$, $POCl_3$-$SnCl_4$.

Ohio State U. Research Foundation, Columbus.
RARE EARTH OXIDES. III. THE HEAT CAPACITIES OF YTTRIUM OXIDE ($Y_2O_3$), LANTHANUM OXIDE ($La_2O_3$) AND NEODYMIUM OXIDE ($Nd_2O_3$) FROM 16 TO 300°K, by H. W. Goldstein, E. F. Neilson and others. Technical rept. no. 3 on Contract AF 18(600)1545. Oct 58, 21p. 12 refs. AFOSR [TN]-58-1095; AD-207 596.
Order from LC mi$2.70, ph$4.80 PB 139 428

The entropies, enthalpies, and free energy functions have been calculated from the heat capacity data and are tabulated for several temperatures. The free-energy functions have been extended to 2500°K by the use of some higher temperature heat capacity data available in the literature.

## Organic Chemistry

California U., Berkeley.
FORMATION OF METHYL NITRITE IN THE PHOTOLYSIS OF GASEOUS NITROMETHANE, by George C. Pimentel and Gerry Rollefson. Rept. on Contract AF 49(638)1. 28 Feb 59, 13p. 6 refs. AFOSR-[TN]-59-266; AD-212 469.
Order from LC mi$2.40, ph$3.30 PB 142 840

By infrared spectroscopic analysis methyl nitrite was found to be a product of photolysis of gaseous nitromethane. Its growth as a function of photolysis time shows that this product is itself photolyzed but that only a fraction of the decomposed parent molecules form methyl nitrite. The results are discussed in terms of the proposal that excited methyl nitrite is formed by recombination of $CH_3$ and $NO_2$ radicals formed in the primary photolytic process. These experiments cast light on the cage effect in the photolysis of nitromethane in solid argon, as studied by Brown and Pimentel.

Maine U., Orono.
THE PREPARATION AND REACTIONS OF COMPOUNDS OBTAINED BY THE ANHYDROUS CHLORINATION OF ORGANIC SULFUR COMPOUNDS, by Irwin B. Douglass. Final technical rept. on Contract Nonr-647(00). 10 Mar 58, 16p. 9 refs.
Order from LC mi$2.40, ph$3.30 PB 142 583

The chemistry of the aliphatic derivatives of sulfur has taken on new significance in view of the ready availability of mercaptans and disulfides as by-products of the petroleum and pulp and paper industries. The results achieved under this project have extended and clarified the reactions of these compounds and have made compounds readily available which were previously unknown or could be prepared only with difficulty.

Naval Research Lab., Washington, D. C.
REACTIONS OF ORGANOPHOSPHORUS ACIDS WITH ISOCYANATES. PART I. THE BASE-CATALYZED CONDENSATION, by R. B. Fox. Interim rept. 31 July 59, 11p. 18 refs. NRL rept. 5360.
Order from OTS $0.50 PB 151 806

Tertiary amine salts of acids containing reactive hydrogen atoms bonded to carbon or phosphorus have been found to undergo a base-catalyzed reaction with isocyanates to yield the corresponding C- or P-carbamoyl derivatives. The acids are exemplified by phenylacetic acid and phenylphosphinic acid. The latter acid can also be converted to phenyl(phenylcarbamoyl)phosphinic acid by way of an Ivanov reaction in which a salt of a P-Grignard reagent is utilized. O-carbamoyl derivatives are formed by reaction of isocyanates with the half salts of dibasic acids such as phosphonic acids. Strongly acidic hydroxyl groups bonded to phosphorus do not undergo this type of reaction.

Naval Research Lab., Washington, D. C.
TAUTOMERISM IN PHOSPHORUS CHEMISTRY. PART II. IODINATION OF DI-n-BUTYL PHOSPHONATE IN n-BUTYL ALCOHOL, by R. B. Fox. Interim rept. 24 July 59, 23p. 17 refs. NRL rept. 5335.
Order from LC mi$2.70, ph$4.80 PB 140 391

A study of the iodination of di-n-butyl phosphonate in n-butyl alcohol has been carried out. The reaction, which yields tri-n-butyl phosphate as a major product, is in many ways similar to the hydrogen isotope exchange in dialkyl phosphonates. The iodination is qualitatively subject to both general acid and base catalysis, the latter predominating; reaction rates, therefore, generally increase as acid concentrations decrease or as base concentrations increase. In the absence of added catalysts, the reaction is autocatalyzed. The rate of the acid-catalyzed reaction is independent of the iodine concentration, and the mechanism of the reaction appears to involve tautomerization. Reaction in the presence of bases is dependent upon the iodine concentration; the concept of tautomerization is shown to be unnecessary to explain the experimental results under these conditions. (See also PB 151 227)

Pennsylvania State U., University Park.
STEREOSPECIFIC TRANS RADICAL ADDITION OF DBr TO THE 2-BUTENES SYNTHESES OF ERYTHRO- AND THREO-3-DEUTERO-2-BROMOBUTANES, by Philip S. Skell and Richard G. Allen. Rept. on Contract AF 49(638)457. 31 Mar 59, 13p. 3 refs. AFOSR TN-59-388; AD-214 508.
Order from LC mi$2.40, ph$3.30 PB 142 682

Pure erythro- and threo-3-deutero-2-bromobutanes can be synthesized by radical chain additions of deuterium bromide to trans- and cis-2-butenes, respectively. Structures and purity were determined by alkaline dehydrohalogenation, erythro- yielding trans-2-butene and cis-2-deutero-2-butene, threo- yielding cis-2-butene and trans-2-deutero-2-butene. The mechanistic implications are considered.

Pennsylvania U., Philadelphia.
INVESTIGATION OF THE THERMAL STABILITY OF PORPHYRINS, by J. F. Hazel, W. M. McNabb and others. Rept. on Research on New Chemical Systems and Methods of Synthesis, Contract AF 33(616)5637. May 59, 25p. WADC Technical rept. 59-274.
Order from OTS $0.75 PB 161 004

This research was carried out to gain information about the thermal stability of tetraphenylporphyrins and other related compounds up to temperatures of 1000°F. The work was divided into two broad categories: (1) the thermal stability of porphyrins and phthalocyanins when heated in air. (2) the thermal stability of porphyrins in a closed evacuated system.

## Physical Chemistry

Atlantic Research Corp., Alexandria, Va.
FLAME STRUCTURE STUDIES. IV. PREMIXED CARBON MONOXIDE COMBUSTION, by Raymond Friedman and Robert G. Nugent. Rept. on Contract Nonr-1858(25). Apr 58, 20p. 8 refs. Proj. Squid Technical rept. ARC-3-P.
Order from LC mi$2.40, ph$3.30 PB 142 593

Bureau of Mines, Pittsburgh, Pa.
CONSIDERATIONS PERTAINING TO SHPERICAL-VESSEL COMBUSTION, by J. Grumer, E. B. Cook and T. A. Kubala. Rept. on Contract Nonr-1858(25). Apr 58, 20p. 12 refs. Proj. Squid Technical rept. BUM-25-P.
Order from LC mi$2.40, ph$3.30 PB 142 594

The measurement of burning velocity by means of a closed spherical vessel is a procedure of long standing. The spherical-vessel method has also been used to determine the pressure dependence of the burning velocity. This paper deals mainly with recent improvements in theory and verification of the previous finding that the pressure exponent of the burning velocity is positive for some mixtures. The ability to approxi-

mately measure expansion ratios of gases burning in a closed vessel and new tests for thermochemical equilibrium in the burned gases and some miscellaneous considerations are also reported.

Catholic U. of America, Washington, D. C.
THE REACTIONS OF HYDROGEN ATOMS WITH OXYGEN, by B. deB. Darwent and V. J. Krasnansky. Rept. on Contract Nonr-1858(25). Apr 58, 20p. 8 refs. Proj. Squid Technical rept. CUA-1-P.
Order from LC mi$2.40, ph$3.30 PB 142 493

Cornell Aeronautical Lab., Buffalo, N. Y.
COMPOSITION TRAVERSES IN CURVED LAMINAR FLAME FRONTS, by George H. Markstein. Rept. on Contract Nonr-1858(25). Apr 58, 23p. 21 refs. Proj. Squid Technical rept. CAL-75-P.
Order from LC mi$2.70, ph$4.80 PB 142 491

In the present work sampling methods similar to those developed by others have been applied to steady, essentially two-dimensional cellular flames. These flames were selected because they contain curved regions in which pronounced transport across flow lines should occur, while, nevertheless, their geometry is fairly simple. It is by no means implied by this choice, however, that cellular flames are the only ones in which transport across flow lines may be significant.

Cornell U., Ithaca, N. Y.
OXIDATION OF EVAPORATED MAGNESIUM FILMS, by Mitchell S. Cohen. Doctoral thesis. Technical rept. no. 2 on Contract Nonr-401(31). 15 Sep 58, 159p. 99 refs. AD-204 578.
Order from LC mi$7.50, ph$24.30 PB 142 515

The Wagener flow-method was applied to the study of the low-temperature and low-pressure oxidation of evaporated magnesium films. The oxidation kinetics in both the first period of high takeup rate and the later period of rapidly-falling takeup rate were studied, and the surface structure of the magnesium films was concurrently investigated by electron diffraction and electron microscopy. The data from the first period of oxidation are discussed in terms of a nucleation phenomenon; the data from the second period of oxidation are discussed in terms of the current theories of oxidation for the thin oxide-film region.

Delaware U., Newark.
SPECTROPHOTOMETRIC STUDIES OF LAMINAR FLAMES. I. THE DECAY OF RADICAL RADIATION by Edward T. Child and Kurt Wohl. Rept. on Contract Nonr-1858(25). Apr 58, 30p. 7 refs. Proj. Squid Technical rept. DEL-9-P.
Order from LC mi$2.70, ph$4.80 PB 142 516

The spectrophotometric studies of the structure of laminar flame fronts which had been undertaken by Wohl and Welty have been continued in various directions. The procedure consists in viewing a flat flame edgewise by an instrument with a very small aperture, and moving the flame front perpendicularly to the optical axis.

Delaware U., Newark.
SPECTROPHOTOMETRIC STUDIES OF LAMINAR FLAMES. II. THE FLAME FRONT, by Raymond Kushida and Kurt Wohl. Rept. on Contract Nonr-1858(25). Apr 58, 30p. 4 refs. Proj. Squid Technical rept. DEL-10-P.
Order from LC mi$2.70, ph$4.80 PB 142 517

(See also PB 142 516)

Electrochemical Research Lab., Western Reserve U., Cleveland, Ohio.
THE ELECTROCHEMISTRY OF NICKEL: I. CODEPOSITION OF NICKEL AND HYDROGEN FROM SIMPLE AQUEOUS SOLUTIONS, by John Yeager, J. P. Cels and others. Technical rept. no. 9 on Contract Nonr-58100. 15 Apr 58, 43p. 33 refs.
Order from LC mi$3.30, ph$7.80 PB 142 562

The nickel polarization has a Tafel slope of 0.10 and is independent of pH and type of anion at constant nickel ion activity. Hydrogen and nickel deposition appear to occur without any appreciable interdependence over the range of condition involved in the present work.

Linfield Research Inst., McMinnville, Ore.
RESEARCH ON ELECTROLYTIC MICROMACHINING TECHNIQUES OF REFRACTORY METALS FOR USE IN FIELD EMISSION DEVICES, by H. W. Pitman and D. C. Hamby. Quarterly progress rept. no. 2, 15 Oct 58-15 Jan 59, on Contract DA 36-039-sc-78191. [1959] 41p. 12 refs.
Order from LC mi$3.30, ph$7.80 PB 142 704

The optical interference method for the accurate determination of the thickness of anodically formed oxide films on tungsten is reviewed. A preliminary experimental value of 2.1 for the refractive index of the oxide anodically formed on tungsten was obtained. The application of a spectrophotometric method for analysis of trace amounts of tungsten is reviewed.

Massachusetts Inst. of Tech., Cambridge.
IGNITION OF AND FLAMES ABOVE HYDROGEN PEROXIDE SOLUTIONS, by Charles N. Satterfield, Ephraim Kehat, and Maria A. T. Mendes. Rept. no. 54 on Contract Nonr-1841(11). 15 Oct 58, 36p. 9 refs.
Order from LC mi$3.00, ph$6.30 PB 142 822

The purpose of the present work was to determine the limiting conditions under which such flames can be ignited and to establish some of the characteristics of such flames, particularly the rate of burning.

Massachusetts Inst. of Tech., Cambridge.
IONOZATION IN DETONATION WAVES, by Satyaki Basu and James A. Fay. Rept. on Contract Nonr-1858(25). Apr 58, 17p. 14 refs. Proj. Squid Technical rept. MIT-17-P.
Order from LC mi$2.40, ph$3.30 PB 142 553

Using a simple d. c. probe technique, measurements have been made of the electrical conductance of stoichiometric oxy-hydrogen detonation waves with

initial pressures of 1/10 to 1 atmosphere, and of oxy-acetylene detonation waves at one atmosphere initial pressure with mixture composition varying from 30 per cent $C_2H_2$ to 80 per cent $C_2H_2$.

Metals Research Lab., Carnegie Inst. of Tech., Pittsburgh, Pa.
EFFECTS OF ALUMINUM ON THE FORMATION OF ALPHA IN Ti-Mo AND Ti-Mn ALLOYS, by Hubert I. Aaronson, Walter B. Triplett and others. Final rept. for 1 Dec 55-31 May 58 on Contract Nonr-760(12). 31 May 58, 22p. 19 refs. AD-201 795.
Order from LC mi$2.70, ph$4.80 PB 142 557

In Ti-Mo-base alloys, the effect of aluminum is to raise the temperature at which a given structure will appear by 50-75°C. The TTT-curves for the initiation and the completion of transformation are displaced to shorter reaction times in the ternary alloy. In Ti-Mn-base alloys, the addition of aluminum again increased the temperature at which a given alpha structure developed.

Michigan U., Ann Arbor.
LOW-TEMPERATURE HEAT CAPACITY AND THERMODYNAMIC PROPERTIES OF SODIUM METHOXIDE, by E. F. Westrum, Jr. and G. Grenier. Rept. on Contract NOa(s)-52-1024-c. 26 Mar 57, 9p. 3 refs. Rept. no. CCC-1024-TR-233.
Order from LC mi$1.80, ph$1.80 PB 142 756

Heat capacities of sodium methoxide from 5° to 345°K were measured. The heat-capacity curve has the normal sigmoid shape except for a small deflection of undetermined origin near 34°K. This deflection involves an excess entropy of about 0.43 caloric per mole per degree. The following thermodynamic functions at 298.16°K were determined (molal values): heat capacity at constant pressure, $16.60 \pm 6$ calories; and free-energy function, $-15.12 \pm 0.03$ calories per degree.

Naval Research Lab., Washington, D. C.
ELECTROCHEMICAL MECHANISMS OF NOBLE-METAL/HYDROGEN SYSTEMS. PART IV. TRANSPORT OF HYDROGEN AND DEUTERIUM THROUGH METALS, by S. Schuldiner and J. P. Hoare. 31 July 59, 40p. 21 refs. NRL rept. 5333.
Order from LC mi$3.00, ph$6.30 PB 140 353

Hydrogen isotopes can be transported through palladium by two different processes: atomic diffusion and electrochemical migration of cations. These processes were investigated for hydrogen and deuterium, and mechanisms were determined. A preliminary investigation, using palladium-clad electrodes, of hydrogen transport through platinum, nickel, gold, and steel was also carried out. It was shown that under the experimental conditions used transport of hydrogen through nickel and gold did not occur. Hydrogen, however, did dissolve and migrate as protons through platinum, whereas it can either migrate as protons or diffuse as atoms through steel or palladium.

Naval Research Lab., U. of Wisconsin [Madison].
STATISTICAL MECHANICS, by C. F. Curtiss. Rept. on Contract N7onr-285(11). 16 Dec 57, 37p. 95 refs. WIS-ONR-27; AD-153 311.
Order from LC mi$3.00, ph$6.30 PB 139 401

Statistical mechanics aims at the interpretation of the observed or macroscopic properties of matter in bulk in terms of the mechanical properties of the constituent molecules and their interaction. It is a perhaps obvious principle of statistical mechanics that a complete knowledge of the properties of individual molecules and their interactions is sufficient for the prediction of the observed properties of bulk matter. If the molecules, i.e. the repetitious units, are sufficiently simple, a good deal of progress has been made toward actually accomplishing these possibilities.

Notre Dame U., Ind.
THE KINETICS OF SrO ON W AND Mo BY FIELD ELECTRON MICROSCOPY, PART I, by J. A. Cape, G. J. Baldwin and E. A. Coomes. Reprint series. Technical rept. on Contract Nonr-1623(01). 8 Dec 57, 39p. 13 refs.
Order from LC mi$3.00, ph$6.30 PB 142 449

Thin films of BaO or SrO deposited on W or Mo by evaporation give thermionic emissions comparable with good conventional oxide cathodes. To investigate the mechanism of work-function-lowering, Haas and Cooms attempted to measure the periodic Schottky deviations for SrO on Mo. In view of observed kinetics of adatoms on a metal surface with patches of different work function, the thermionic electrons from SrO on W or Mo in a stable state are probably emitted principally from a few low-work-function areas on the emitter. The object of the research reported here was to ascertain the physical makeup of these patches; the techniques of field electron microscopy were employed.

Rice Inst., Houston, Tex.
ELECTROLYTIC DEPOSITION OF CARBON, by R. G. Gentile. Final rept. for 1 July-31 Dec 51 on Verification of a Method of Deposition or Growth of Carbon, Contract DA 36-039-sc-15368. 20 Jan 52, 14p.
Order from LC mi$2.40, ph$3.30 PB 142 659

The proposed method of electrodeposition of carbon by reduction of carbon tetrachloride in a sodium arc fails under the condition experimented. A microscopic analysis of the deposit failed to show any crystalline structure.

Stanford Research Inst., Menlo Park, Calif.
STUDY OF THE MECHANISMS OF FIRE EXTINGUISHMENT OF LIQUID ROCKET PROPELLANTS, by Willis A. Rosser, Jr., S. Henry Inami, and Henry Wise. Rept. for 15 Mar 58-Apr 59 on Contract AF 33(616)5558. Apr 59, 45p. 22 refs. WADC Technical rept. 59-206; AD-216 355.
Order from OTS $1.25 PB 151 962

The inhibition of various premixed and diffusion flames by halogen-containing compounds has been studied.

The results indicate that the nature of the oxidizer is the most important single factor in determining sensitivity or lack of sensitivity to chemical inhibition. With minor exceptions, combustion with oxygen can be chemically inhibited. The fuel may be any compound or any mixture of compounds which contains substantial quantities of hydrogen. Known exceptions are organic nitro and nitrate compounds; the presence of either of these groups in the fuel interferes with the inhibition mechanism. The applicability of these conclusions to fuels which contain metals such as boron is not known.

Texas U., Austin.
THE RELATIVE INTENSITIES OF ABSORPTION BANDS IN LIQUID AND GAS PHASES FROM DISPERSION THEORY, by E. E. Ferguson. [1959] 6p. 7 refs. AFOSR-TN-59-287.
Order from LC mi$1.80, ph$1.80 PB 142 839

## EARTH SCIENCES

Chesapeake Bay Inst., Johns Hopkins U. [Annapolis], Md.
YORK RIVER CRUISE 29 JULY-1 AUGUST 1954. Rept. on Contracts Nonr-248(20) and Nonr-248(30), Sep 57, 35p. Data rept. 30; Ref. 57-5.
Order from LC mi$3.00, ph$6.30 PB 138 962

The purpose of this cruise was to study the physical and chemical structure of the area.

Massachusetts Inst. of Tech., Cambridge.
ATMOSPHERIC WATER VAPOR DIVERGENCE AND THE WATER BALANCE AT THE EARTH'S SURFACE, by Daniel H. Lufkin. Scientific rept. no. 4 on General Circulation Project, Contract AF 19(604)2242. June 59, 46p. 32 refs. AFCRC-TN-59-409; AD-217 037.
Order from LC mi$3.30, ph$7.80 PB 142 709

After reviewing the nature and derivation of the northern hemisphere water vapor divergence data published by Starr and Peixoto (1958), the author presents a new and more detailed analysis of the divergence field. The relation between the atmospheric moisture divergence and the terrestrial branch of the hydrologic cycle is examined in the light of the geology and physiography of many regions which are associated with marked moisture divergence maxima and minima. The relation between the moisture divergence over the seas and the water budget of the sea surface is considered in a new treatment of the empirically derived correlation between salinity and moisture divergence, resulting in a new formula for the zonal mean salinity as a function of the zonal mean divergence. The latitudinal variation of the landward transport of oceanic moisture is calculated and is the first estimate ever made of this quantity. Finally, the implications of the latent heat transported by moisture are discussed in relation to the formulation of numerical models of the general circulation.

Rutgers U. [New Brunswick, N. J.]
CARBON 14 DATING OF SOME ARCTIC SOILS, by J. C. F. Tedrow and L. A. Douglas. [Rept. on Contract Nonr-1138(01)]. Jan 58, 6p. 9 refs.
Order from LC mi$1.80, ph$1.80 PB 139 250

## Climatology and Meteorology

Allied Research Associates, Inc. [Boston, Mass.]
SOME APPLICATIONS OF THE CAPPI TECHNIQUE OF RADAR PRESENTATION IN SYNOPTIC DIAGNOSIS AND RESEARCH, by Roland J. Boucher. Scientific rept. no. 1 on Contract AF 19(604)5204. 30 Mar 59, 31p. 7 refs. AFCRC TN-59-264; AD-212 971.
Order from LC mi$3.00, ph$6.30 PB 142 469

CAPPI records of the McGill CPS-9 radar comprising four cyclonic, cold-season precipitation periods are analyzed. The CAPPI technique is found to have valuable applications as an additional tool in the synoptic diagnosis of precipitating systems and for research purposes but as a supplement rather than a replacement for the conventional PPI and RHI techniques. For operational use outside of the "umbrella" area the practical advantages of CAPPI over those of other presentations in this type of situation are not self-evident from this limited analysis. The use of CAPPI in summer convective situations is not considered.

Laboratory of Climatology, Centerton, N. J.
INSTRUCTIONS AND TABLES FOR COMPUTING POTENTIAL EVAPOTRANSPIRATION AND THE WATER BALANCE, by C. W. Thornthwaite, J. R. Mather and D. B. Carter. Technical rept. no. 5 on Contract Nonr-1617(00). 1957, 131p. 3 refs. Publications in Climatology, vol. 10, no. 3.
Order from LC mi$6.90, ph$21.30 PB 142 395

Laboratory of Climatology, Centerton, N. J.
STUDY OF TIME-HEIGHT VARIATIONS OF MICROMETEOROLOGICAL FACTORS DURING RADIATION FOG. PART I: THE PHYSICAL PROCESSES IN THE FORMATION OF RADIATION FOG. PART II: INSTRUMENT DEVELOPMENT, by Francis K. Davis, Jr. Final rept. on Contract AF 19(604)1118. 1957, 98p. 75 refs. Publications in Climatology vol. 10, no. 1, AFCRC-TR-57-210; AD-113 677.
Order from LC mi$5.40, ph$15.30 PB 139 413

An understanding of the physical processes which occur before and during the formation of radiation fog is a basic necessity for forecasting its development. Under conditions favorable for the formation of radiation fog the physical processes operating in the lowest few meters of the atmosphere are radiation, advection and eddy diffusion. Radiation would not affect the water vapor distribution, but if the temperature stratification were stable and wind speeds light, radiation might outweigh eddy diffusion in its effect on the temperature profile. It is theorized that under such conditions, eddy diffusion acts to produce a water vapor maximum at some level separated from the ground and that this would be a definite contributing factor in the formation of radiation fog.

Little, Arthur D., Inc., Cambridge, Mass.
GIANT ELECTRICAL STORMS, by Bernard Vonnegut and Charles B. Moore. Rept. on Contract Nonr-1684(00). 15 Mar 58, 22p. 28 refs.
Order from LC mi$2.70, ph$4.80 PB 142 584

The storms that produce tornadoes are generally more vigorous, larger, and more electrically active than ordinary thunderstorms. Not only do they give a far higher frequency of lightning strokes, but they also exhibit a variety of luminous electrical phenomena unknown in common storms. A remarkable feature is that they frequently penetrate well into the stratosphere, reaching heights of 20 km or more. To do this, they must have vertical velocities of about 100 m $sec^{-1}$. The very low temperature in the upper half of these storms apparently precludes electrification mechanisms in this region involving liquid water or precipitation formation.

MacDonald Physics Lab., McGill U. (Canada).
ELECTRONIC CONSTANT ALTITUDE PLAN POSITION INDICATOR FOR A WEATHER RADAR, by T. W. R. East. Rept. on Contract AF 19(604)1579. Nov 58, 92p. 3 refs. Stormy Weather Research Group Scientific rept. MW-28; AFCRC TN-58-614.
Order from LC mi$5.40, ph$15.30 PB 142 556

The Constant-Altitude Plan Indicator (CAPI) is a type of display developed for use with a weather radar, and supplements or replaces the PPI displays normally found on such radars. When in operation, the CAPI will display the precipitation echoes being received by the radar from all over a shallow region which lies at a fixed altitude above the earth's surface. Such a layer-type display is expected to have much more meaning for the meteorologist, than the usual picture of weather echoes from a conical region which is displayed when a PPI is operated with the antenna tilted at some fixed elevation angle. A radar located on the ground cannot quickly probe an elevated horizontal region of the atmosphere, because the beam from the antenna passes obliquely through the layer and views only a small protion of it at one time. To probe the elevated region completely requires a lengthy scanning process during which the radar receives much information, small portions of which come from the layer in question; the relevant parts are stored up in an electrostatic storage tube. The system (as built in prototype form) consists of eleven chassis plus power supplies (see SWE 42 in Appendix). Descriptions of each chassis follow in chapter 2.

McGill U. (Canada).
CONTRIBUTIONS TO THE STUDY OF THE ARCTIC CIRCULATION: A REPORT ON THE SECOND SEMINAR IN ARCTIC METEOROLOGY AT STANSTEAD COLLEGE, QUEBEC, JULY 29th TO AUGUST 9th, 1957, by C. V. Wilson. Scientific rept. no. 7 on Contract AF 19(604)1141. Mar 58, 106p. 7 refs. Arctic Meteorology Research Group Pub. in Meteorology no. 9; AFCRC TN-58-250; AD-152 485.
Order from LC mi$5.70, ph$16.80 PB 142 473

Rept. on the Second Seminar in Arctic Meteorology at Stanstead College, Que., July 29th-August 9th, 1957.

The following papers were among those presented at the seminar: (1) Canadian meteorological program for the IGY, by W. L. Godson; (2) Models for numerical weather prediction, by W. L. Godson; (3) High-level fields of wind and temperature over the Canadian Arctic, by W. L. Godson; (4) The wintertime circulation in the Arctic troposphere, by T. J. Keegan; (5) Arctic synoptic analysis, by R. J. Reed; (6) Cold polar vortices, by R. J. Reed; (7) A baroclinic graphical prediction model, by R. J. Reed.

Massachusetts Inst. of Tech., Cambridge.
SYNOPTIC APPLICATION OF DYNAMICAL CONCEPTS, ed. by Frederick Sanders. Final rept. on Contract AF 19(604)1305. 28 Feb 59, 95p. 1 ref. AFCRC-TR-59-227; AD-212 267.
Order from LC mi$5.40, ph$15.30 PB 142 508

The occurrence of cloudiness and precipitation was investigated in relation to the large-scale vertical motion calculated from a simple dynamical model. The weather was found to be related to vertical motion in the expected sense. The degree of the association was limited by lack of precision in specification of the field of moisture, by the small scale of many cloud systems and precipitation systems in general, and by the operation of low-level cloud-forming processes which are not sensitive to large-scale vertical motion. A study of divergence and vertical motion as determined by the kinematic technique indicates that these quantities are rather irregularly distributed in the vertical in any particular instance but that Dines compensation tends to operate on the average (that is, the average magnitude of the divergence reaches a minimum in the middle troposphere). Kinematic and adiabatic measurements both indicated large vertical motion, of the order of 10 cm $sec^{-1}$, extending well into the lower stratosphere in the vicinity of an intensifying cyclone.

Naval Research Lab., U. of Wisconsin, Madison.
RECURRENCE FORMULAE FOR THE INTERACTION COEFFICIENTS OCCURRING IN THE THEORY OF ATMOSPHERIC PLANETARY WAVES, by M. P. Barnett. Rept. on Contract N7onr-28511. 19 May 58, 8p. 9 refs. WIS-ONR-34.
Order from LC mi$1.80, ph$1.80 PB 142 525

Recurrence formulae are derived for the harmonic interaction coefficients of theoretical meteorology. These formulae would be particularly useful in high speed digital computation.

Pennsylvania State U. Mineral Industries Experiment Station, University Park.
RESEARCH DIRECTED TOWARD THE STUDY OF THE RELATION OF SOLAR ENERGY VARIATIONS TO CHANGES OF THE TROPOSPHERIC CIRCULATIONS, by Mae D. Lethbridge, Hans A. Panofsky, and Hans Nueberger. Final rept. on Contract AF 19(604)2251. 30 June 58, 50p. 14 refs. AFCRC TR-58-263.
Order from LC mi$3.30, ph$7.80 PB 142 566

This report summarizes various applications of spec-

trum analysis and Chree analysis to solar-weather relations. It is shown that at times of 27-day recurrent magnetic storms, the spectrum of the zonal index tends to have an unusually sharp peak near 27 days. This peak is characteristic of total hemispheric indices, in the eastern half of the hemisphere, but not of the western half. Sunspots and storm frequency show no coherence. Cosmic ray neutron count also shows a strong spectrum peak at 27 days, which has considerable coherence with hemispheric zonal index at 500 mb at latitude 60° N. A Chree analysis between cosmic ray count and zonal indices, with lunar maximum north declination as zeroth day, show an in-phase relationship at 60° N. and an out-of-phase relationship at 45° N. Polar vortex breakdowns at 100 mb during the last 13 years appear to be preceded, on the average, by a rise in magnetic activity several days before the breakdowns.

Pennsylvania State U. Mineral Industries Experiment Station, University Park.
STRUCTURE OF ATMOSPHERIC TURBULENCE CLOSE TO THE SURFACE OVER SMOOTH TERRAIN, by Hans A. Panofsky and V. R. K. Rao. Final rept. on Proj. Prairie Grass, Contract AF 19(604)2252. 15 Oct 58, 70p. 13 refs. AFCRC-TR-58-283.
Order from LC mi$3.90, ph$10.80 PB 139 368

This report summarizes a number of applications of diffusion and fine-structure data. The following conclusions were: (1) At night, the general shapes of the Eulerian and Lagrangian correlation functions tend to be similar, with the Lagrangian time scale about four times the Eulerian time scale, in cases where both can be estimated. At daytime, the scales are more nearly equal. Both functions fluctuate strongly with stability. (2) Taylor's hypothesis regarding the relation between time and space correlations appears to be well satisfied up to a distance of 90 meters. (3) The assumption of a normal distribution and a constant wind leads to good estimates of maximum concentration of effluent, and of areas of dangerous concentration, if the source strength, horizontal and vertical effluent dispersion variances are known. Two methods estimating these variances from wind and stability are discussed and compared with observations. (5) The spreading of effluent at a given distance from the source increases with increasing wind at night, but decreases in unstable stratification. (6) Techniques to estimate spectra from wind, height and lapse rate are modified and tested. Various techniques used to estimate ionospheric drift on the basis of cross correlation analysis are tested. (8) Correlation functions following the mean wind seem to have similar properties as those following individual particles. (9) The scale at right angles to the flow is much smaller than that along the flow at night, but about the same at daytime.

Texas A. and M. Coll., College Station.
THE THEORY OF ANALYSIS AND PREDICTION OF TRAJECTORIES, by Guy A. Franceschini. Final rept. on Contract AF 19(604)1302. Oct 58, 106p. 13 refs. Reference 58-18F; AFCRC-TR-58-281.
Order from LC mi$5.70, ph$16.80 PB 142 504

Studies conducted were grouped into the three following categories with objectives as noted: (1) theory of trajectories, - directed toward development of prediction methods, (2) analyses of observed trajectories, - directed toward determination of operational use of observed balloon flights. (3) use of predicted trajectories, - directed toward meteorological use of trajectory predictions. Results in the three categories were obtained. A theoretical note relating to trajectories, of a preliminary nature, is presented. Also, a theoretical discussion of trajectories in the vicinity of the "jet stream" is given. The latter suggests a possible reason for the existence of isotach centers observed on daily charts.

Texas A. and M. Research Foundation, College Station.
ATMOSPHERIC FIELD EQUATIONS BASED ON A VARIATIONAL PRINCIPLE WITH APPLICATION TO THE MOTION OF CLOSED SYSTEMS, by Yoshikazu Sasaki. Scientific rept. no. 3 on Contract AF 19(604)2222. Oct 58, 27p. 12 refs. Reference 58-19T; AFCRC TN-58-630.
Order from LC mi$2.70, ph$4.80 PB 139 425

Canonical formalism for the atmospheric "flow field" is derived based on the variational principle. Application of results to the motion of closed systems introduces various terms which may be significant. Since there are certain phenomena which may be treated as closed systems, - such as hurricanes, severe storms, and at times constant pressure balloons, suggestions are made of the possible importance of these various terms in the prediction problem.

Texas A. and M. Research Foundation, College Station.
A NUMERICAL TECHNIQUE FOR PREDICTING WIND FIELDS USING A LAGRANGIAN APPROACH, by Stanley L. Barnes. Scientific rept. no. 5 on Contract AF 19(604)2222. Oct 58, 23p. 2 refs. Reference 58-21T; AFCRC TN-58-650.
Order from LC mi$2.70, ph$4.80 PB 139 426

A numerical technique for predicting the wind field using a Lagrangian approach is presented. Two equations are used which determine Lagrangian accelerations in terms of the fields of velocity and geopotential. The first is based on the simplified equations of horizontal, frictionless motion of a particle; the second is based on a variational principle as applied to the motion of a closed system. These equations are used separately to obtain the individual change in velocity of a parcel. By use of the analytical expansion of the individual change, the local change in velocity is obtained. Using this technique, the equations are solved by finite difference approximations for an array of grid points. The method is tested for three case studies. Based on normally available data, twelve-hour forecast velocities at the 500 mb. surface are obtained by a "marching" process. Results indicate consistent errors are being made in both direction and magnitude of forecast winds. Whether these errors are caused by certain assumptions in the theory or by the technique used has not yet been determined. A large percentage of error is found to be introduced through subjective analyses of the data. Suggestions for further study into the theoretical and technical aspects of the problem are given.

Weather Forecasting Research Center, U. of Chicago, Ill.
A METEOROLOGICAL COORDINATE SYSTEM IN WHICH THE EARTH'S SURFACE IS A COORDINATE SURFACE, by Wayne E. Sangster. Scientific rept. no. 8 on Contract AF 19(604)2179. May 59, 48p. 6 refs. AFCRC-TN-59-299; AD-216 315.
Order from LC mi$3.30, ph$7.80 PB 142 601

A coordinate system is presented in which pressure as the vertical coordinate is replaced by an independent variable defined so as to make the earth's surface a coordinate surface. With increasing elevation the coordinate surfaces gradually become isobaric, and above a certain level, which here for convenience is chosen to be 500 mb, all coordinate surfaces are isobaric. Some basic equations of dynamic meteorology are derived in terms of this coordinate system. A method of representing the field of the horizontal pressure force in nonisobaric coordinate surfaces, using geostrophic stream and potential functions, is described.

## Geodesy

Center for Aerial Photographic Studies, Cornell U., Ithaca, N. Y.
A SOLUTION OF THE GENERAL ANALYTICAL AEROTRIANGULATION PROBLEM, by Arthur J. McNair, Hugh Frank Dodge, and Joseph D. Rutledge. Final technical rept. for June 56-May 58 on Contract DA 44-009-eng-2986. [1958] 131p.
Order from LC mi$6.90, ph$21.30 PB 142 681

This report presents a method of analyzing a photogrammetric bridge or a net to determine the degrees of restraint provided by photographic, ground, and/or exposure station control, and to determine whether sufficient data exists for solution of the net. A count system of tabulating the value of control data simplifies this determination. The system is equally useful to instrumental and analytical photogrammetrists. The report presents an analytical method of performing aerotriangulation which is equally adaptable to single strip cantilever extension, to the general problem of bridging, and to the solution of any arbitrary network of multiple strips of overlapping photographs using any system of successive single or multiple overlapping photographic exposures, and using any type of ground control or camera station control distributed anywhere in the area.

Quartermaster Research and Engineering Center, Natick, Mass.
PREDICTIVE METHODS IN TOPOGRAPHIC ANALYSIS. I. RELIEF, SLOPE, AND DISSECTION ON INCH-TO-THE-MILE MAPS IN THE UNITED STATES, by Walter F. Wood and Joan B. Snell. Apr 59, 36p. 11 refs. Technical rept. EP-112.
Order from LC mi$3.00, ph$6.30 PB 142 476

Based on a 200-case sample of United States topographic maps, a study has been made of the interrelationships of six terrain factors: highest elevation, lowest elevation, relief, contour counts, slope direction changes, and hilltops. The rank method of correlation was used for this analysis. From the preliminary correlations, three factors (relief, contour counts, and slope direction changes) were found to be most significantly related. Further work with these three factors resulted in a series of regression equations, both simple and multiple, to be used for predicting any of these three elements when pertinent data for it are lacking. The performance of two multiple regression equations to predict average slope from relief and from slope direction changes, were mapped.

## Physics of the Atmosphere

Denver U., Colo.
ATMOSPHERIC ABSORPTIONS IN THE NEAR INFRARED AT HIGH ALTITUDES, by David G. Murcray, James N. Brooks and others. Scientific rept. no. 2 on Contract AF 19(604)2069. 8 Dec 58, 29p. 6 refs. AFCRC TN-58-648.
Order from LC mi$2.70, ph$4.80 PB 139 472

The results of a flight with a balloon borne infrared spectrograph are presented. Solar spectra of the region from 1 to 5 microns were obtained at altitudes from 60,000 to 100,000 ft. The atmospheric absorption data obtained from these spectra is compared with theoretical predictions of slant path absorptions and with laboratory data for constant pressure path. It is found that, if the absorption is treated as a function of Pw, the laboratory data and flight data can be fitted by relations of similar form but with different constants. (See also PB 136 877)

Hawaii Inst. of Geophysics, Honolulu.
ABSORPTION AND PHOTOIONIZATION OF ATMOSPHERIC GASES, by K. Watanabe. Final rept. on Contract AF 19(604)1390. [1958] 13p. 9 refs.
Order from LC mi$2.40, ph$3.30 PB 142 527

A photoelectric technique for vacuum ultraviolet photometry was improved from the previous resolution of about 1 A to 0.2 and 0.1 A. These resolutions were obtained by means of a new 1-meter, normal-incidence monochromator with a grating of 1200 lines per mm. Using the improved technique, absorption cross sections of $O_2$, NO, $NO_2$, and $N_2$ were measured in the Schumann region.

Maryland U., College Park.
ON THE CAUSE OF THE MINIMUM IN THE EARTH'S RADIATION BELT, by S. F. Singer. Rept. on Contract AF 19(604)3861. 1959, 8p. 13 refs. AFCRC [TN] 59-436.
Order from LC mi$1.80, ph$1.80 PB 142 710

Michigan U. Research Inst., Ann Arbor.
BI-POLAR PROBE INSTRUMENTATION NO. 1, by N. W. Spencer. Scientific rept. no. FS-1 on Contract AF 19(604)1843 and Contract DA 20-018-509-ORD-103. Oct 58, 18p. 2521; 2816:1-1-S; AFCRC TN-58-617.
Order from LC mi$2.40, ph$3.30 PB 139 470

The design and construction aspects of a bi-polar probe instrumentation for ionospheric investigations are discussed.

New York U. Coll. of Engineering, N. Y.
A PRECISION HYPSOMETER FOR HIGH ALTITUDE BALLOON FLIGHTS, by Robert C. Haymes and Hugo L. L. van Paassen. Technical rept. by Cosmic Ray Group on Contract Nonr-285(21). 15 June 58, 57p. 10 refs.
Order from LC mi$3.60, ph$9.30 PB 142 550

In order to increase the accuracy of atmospheric pressure measurements at balloon altitudes, a hypsometer of novel design has been developed. The instrument is capable of 0.5% accuracy in the range 1000 millibars to 10 mb (100,000 feet). Thus, the accuracy at high altitudes represents an improvement of about a factor of 20 over the conventional measurements, which rely on aneroid cells. The useful life exceeds 8 hours in this range. Design features, tests and flight results are discussed. Several possible improvements are suggested in order to extend the useful range of pressures.

## ENGINEERING

Air Force Missile Development Center, Holloman AFB, New Mex.
THE EFFECT OF DEFOCUSSING OF THE PARABOLIC CONDENSER OF A SOLAR FURNACE, by Alfred W. Simon. June 59, 50p. 4 refs. AFMDC-TN-59-16; AD-216 524.
Order from LC mi$3.30, ph$7.80 PB 142 731

The ratio of the average intensity of light, in successive rings one inch in width moving outward from the axis of a parabolic condenser of a solar furnace, to the intensity in the focal spot of such a furnace is calculated and plotted against the radius of the center of the ring for intercepting planes distant 0, 2.5, and 5.0" from the focal plane.

Chesapeake Bay Inst., Johns Hopkins U. [Annapolis, Md.]
TURBULENT DIFFUSION IN A SECTIONALLY HOMOGENEOUS ESTUARY, by Richard Eugene Kent. Rept. on Contracts Nonr-248(20) and Nonr-248(30). Apr 58, 95p. 22 refs. Technical rept. 16; Reference 58-1.
Order from LC mi$5.40, ph$15.30 PB 142 573

Turbulent diffusion in a well mixed tidal estuary is considered. A practicable theory is presented from which quantitative predictions of mean pollutant-concentration distributions may be obtained for an estuary characterized by steady-state salinity and velocity fields which are considered to vary only in the axial direction. To describe diffusion in this system, a one-dimensional equation is derived which involves a variable coefficient of eddy diffusion. Evaluation of the numerical solution to the diffusion equation requires explicit values along the estuary of the eddy diffusivity for pollutant. The proposed theory is evaluated by comparison with data obtained from flushing tests conducted in model estuaries. From knowledge of an observed initial distribution of the pollutant, several subsequent distributions are computed numerically for two flushing tests using a high speed computing device. The theoretical predictions and the observed data for both tests show reasonable quantitative agreement. A significant feature of the observed tests, namely a downstream skewness of the pollutant distributions, is produced in the numerical solution by the spatial variation of the eddy diffusivity. It is presumed that the theoretical analysis and its numerical solution may be extended from the model system to the prototype and may be used to predict the concentrations in space and time of a conservative pollutant which is dispersing in a well mixed tidal estuary.

## Aeronautical Engineering

Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
MATERIEL INFORMATION FLOW RESEARCH. PART I, by Elmer C. Day. Rept. on Materiel Information Flow Research. Mar 59, 177p. WADC Technical rept. 59-122; AD-211 657.
Order from OTS $3.00 PB 151 950

A system is presented for mechanizing a base supply operation with an electronic computer. This system was tested by operating in parallel with an existing base supply. Some of the difficulties encountered are discussed. The characteristics of an ideal computer for such an application are outlined.

Air Force Cambridge Research Center, Bedford, Mass.
ANALYSIS OF AMB OPERATIONS PLAN FOR SUFFOLK COUNTY AFB, by B. F. Greene, Jr., Jonas Hallgrimson and others. Mar 59, 30p. AFCRC-TR-59-145; AD-215 376.
Order from LC mi$2.70, ph$4.80 PB 142 834

The AMB Operations Plan for Suffolk County AFB, dated 1 November 1958 (SAFTAC plan), is compared with USAF General Operational Requirement GOR-133, 9 January 1956, and the USAF RAPCON. The analysis concludes that SAFTAC will, in general, be superior in performance to the current USAF series of RAPCON's, but that it does not represent a substantial step forward except in data processing and display elements. The analysis concludes that SAFTAC will fail to meet many of the USAF requirements as stated in GOR-133, including those regarding security, direct point-to-point flight by all aircraft, building block philosophy, and traffic rate. Other conclusions and recommendations are stated in the analysis.

Air Proving Ground Center, Eglin AFB, Fla.
EMPLOYMENT AND SUITABILITY TEST OF THE MC-1 MAGNETIC COMPASS CALIBRATOR SET, by Charles G. Kohler. Feb 58, 14p. Operational Test rept. APGC TR-58-21.
Order from LC mi$2.40, ph$3.30 PB 142 526

The MC-1 Magnetic Compass Calibrator Set was designed to provide an expeditious means of calibrating and compensating compass systems incorporating C-2 or C-3 flux valve transmitters. The set requires an area free of strong magnetic disturbances but does not require a compass rose or movement of the aircraft, once it is aligned to the magnetic North heading. With this set, the equivalent of a 24- heading compass swing can be accomplished in about 2 1/2 hr with an accuracy of 0.1 degree.

California Inst. of Tech., Pasadena.
THE EFFECT OF A LONGITUDINAL GRAVITY FIELD ON THE SUPERCAVITATING FLOW OVER A WEDGE, by A. J. Acosta. Rept. on Contract Nonr-220(24). May 58, 17p. 7 refs. Engineering Div. rept. no. 79.1.
Order from LC mi$2.40, ph$3.30 PB 142 492

Convertawings, Inc., Amityville, N. Y.
QUADROTOR STUDIES, WHIRL TESTING, AND PARAMETRIC ANALYSIS, by R. K. Beacom, H. E. Lemont and others. Summary rept. on Contract DA 44-177-tc-411. 15 Dec 58, 58p. 30 refs. Rept. no. YB-1535; AD-148 495.
Order from LC mi$3.60, ph$9.30 PB 142 581

Results of a program of experimental research and design study of the Quadrotor helicopter concept are presented. Hovering tests of a Quadrotor arrangement of model rotors and results of whirl stand stress surveys on the highly simplified rotor and hub system possible with this design concept are reported. Design studies of Quadrotor applications to potential Army missions are shown and a summary presented of the solutions offered by the Quadrotor to contemporary helicopter problems. Results of the program indicate that the Quadrotor concept offers a superior vertical-flight system with reduced maintenance, capable of achieving both operational economy and the manufac-

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RESEARCH ON ROTATING STALL IN AXIAL FLOW COMPRESSORS. PART I. ON LIFT HYSTERESIS AT MAXIMUM LIFT INCLUDING EFFECT OF CAMBER, by R. A. Hartunian. Rept. on Contract AF 33(616)3558. Jan 59, 34p. 12 refs. WADC Technical rept. 59-75, Pt. 1; AD-216 301.
Order from OTS $1.00 PB 151 948

A theoretical investigation is conducted on the effect of airfoil camber on the magnitude of lift hysteresis at maximum lift generated by unsteady boundary-layer phenomena. The effect is demonstrated by comparing the lift hysteresis calculated for an 8-1/2% cambered 6:1 elliptic cylinder oscillating in a plunging mode about maximum lift with that for an uncambered 6:1 elliptic cylinder oscillating in the same mode. In both cases the lift hysteresis loop is generated in a counterclockwise sense. It is found that the effect of camber is to reduce the magnitude of the hysteresis by 40%. This suggests a possible means for controlling the magnitude of this type of lift hysteresis. Calculations for an uncambered elliptic cylinder in pitching oscillation about maximum lift indicate only a small difference in the magnitude of lift hysteresis from the plunging mode.

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RESEARCH ON ROTATING STALL IN AXIAL FLOW COMPRESSORS. PART III. EXPERIMENTS ON LAMINAR SEPARATION FROM A MOVING WALL, by Robert J. Vidal. Rept. on Contract AF 33(616)3558. Jan 59, 33p. 10 refs. WADC Technical rept. 59-75, Pt. 3; AD-216 303.
Order from OTS $1.00 PB 151 959

An experimental program is described which investigates the laminar boundary layer near separation when the wall and separation point are in relative motion. The model used in the investigation was a two-dimensional rotating cylinder which was tested without and with shrouds to impose an airfoil-type pressure gradient. Limited qualitative data are presented which indicate that there is a relatively large displacement of the separation point when the wall and separation point are in relative motion. These data qualitatively substantiate the analysis presented as Part II of the present report. (See also PB 151 948)

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RESEARCH ON ROTATING STALL IN AXIAL FLOW COMPRESSORS. PART IV. A PRELIMINARY STUDY OF THREE-DIMENSIONAL ROTATING STALL, by F. K. Moore. Rept. on Contract AF 33(616)3558. Jan 59, 28p. 7 refs. WADC Technical rept. 59-75, Pt. 4; AD-216 304.
Order from OTS $0.75 PB 151 949

A theoretical study is made of the conditions for existence of the three-dimensional, or partial-span patterns of rotating stall of the axial flow compressor within the framework of small perturbation theory. Two specific problems are considered. For the infinite two-dimensional cascade, it is shown that a spanwise variation of lift perturbation is impossible; i.e., a rotating stall pattern must be aligned with the blades rather than in any skew direction. Second, it is shown by a similar method that no disturbance of lift can propagate relative to the blade elements of an axially-symmetric compressor stage which, in terms of mean flow, produces a free vortex-swirl distribution. These two negative results suggest the value of further research into the geometrical conditions necessary for the existence of three-dimensional propagating stall. For the case of vortex swirl (and also the infinite cascade) a full-span disturbance, having arbitrary amplitude, and traveling with the blade elements, is found to be possible, provided the applicable steady lift curve for all blade elements is a hysteresis loop. (See also PB 151 959)

Cornell Aeronautical Lab., Inc. [Buffalo, N. Y.]
RUDDER KICK MANEUVER STUDY. PART II. ANALYSIS OF VERTICAL AND HORIZONTAL TAIL LOAD DATA OBTAINED DURING RUDDER KICK AND STEADY SIDESLIP FLIGHT TEST MANEUVERS, by James C. O'Hara. Rept. on Contract W33(038)18517. July 57, 140p. 14 refs. WADC Technical rept. 6743, Pt. 2; AD-130 900.
Order from OTS $2.75 PB 151 963

An analysis has been made of flight test data taken during rudder kick and steady sideslip maneuvers of an F-80 Airplane for the purpose of obtaining information which will assist in establishing vertical tail

load design criteria. It was found that the maximum vertical tail load caused by the rudder kick maneuver occurs if the rudder is forced to return at the time of maximum sideslip. Changing the airplane yawing moment of inertia by large amounts by various tip tank configurations had little effect on the maximum vertical tail loads, as was also true of changing the rudder input rate. The F-80 vertical tail loads caused by the rudder kick type maneuver can be predicted within satisfactory accuracy. Assuming three degrees of freedom does not increase the accuracy significantly. There need be no consideration of non-stationary flow.

Douglas Aircraft Co., Inc., El Segundo, Calif.
HYDRAULIC POWER CONTROL SYSTEM OPTIMALIZATION, by W. E. Parsons. Rept. on Contract NOa(s) 54-681C. 9 Sep 55, 208p. 14 refs. Aerodynamic Research rept. no. ES 26037; BUAER rept. AE-61-18.
Order from LC mi$9.30, ph$31.80 PB 142 547

The results of the stability and performance analyses of the systems indicated that the pressure control system and the constant gain flow control system are the two outstanding systems. An initial design of these two systems has been completed and are contained herein.

Ellis and Watts Products, Inc., Cincinnati, Ohio.
AIR CONDITIONER FOR AIR RESCUE SERVICE. Final engineering rept. on Contract AF 30(635)2914. 15 Mar 56, 54p. 6 refs. RADC-TR-57-[202; AD-201 561].
Order from LC mi$3.60, ph$9.30 PB 142 649

An air conditioner was designed, developed, and tested to meet the requirements for a lightweight, 26 Volt DC air conditioner small enough for use for Air Rescue Service Operations.

Engineering Div., Air Materiel Command [Wright-Patterson AFB] Ohio.
HEAT TRANSFER AND TEMPERATURE PROFILES IN LAMINAR BOUNDARY LAYERS ON A SWEAT-COOLED WALL, by E. R. G. Eckert. 3 Nov 47, 16p. 4 refs. Rept. no. 5646; ATI-28 681.
Order from LC mi$2.40, ph$3.30 PB 142 668

Heat transfer and temperature profiles in laminar boundary layers on a sweat cooled wall are dealt with to present some mathematical data relative to the application of sweat cooling in jet and rocket power plants, and to clarify the processes taking place in a sweat cooled wall or part. After a detailed discussion of the physical processes in a sweat cooled wall, the heat transfer from the hot medium to the wall is calculated for two-dimensional stationary flow with laminary boundary layer. The analytical derivation is given for the general case when the velocity outside the boundary layer varies according to an exponential function. The numerical calculations are presented for flow along a flat plate and near the stagnation point. The main results of the calculations show that, with comparatively small velocities of the cooling medium, the heat transfer to the wall can be decreased considerably.

Institute of Flight Structures, Columbia U., New York.
NON-LINEAR CREEP DEFORMATIONS OF COLUMNS OF RECTANGULAR CROSS-SECTION, by H. H. Bleich and O. W. Dillon, Jr. Technical rept. no. 4 on Contract Nonr-266(34). Feb 58, 27p. 8 refs. CU-4-58-ONR-266(34)-CE.
Order from LC mi$2.70, ph$4.80 PB 139 318

The crucial point of the method used in this paper is the recognition that the time rate of curvature of an element of a column has bounds which depend on the bending moment M and its rate of change M at a given instant, but not on the previous history of M. Using these bounds on the rate of curvature, and employing the collocation method, ordinary non-linear differential equations are obtained, from which bounds for the critical time can be computed. The changes in the character of the stress distribution with time, which make the problem so complex, are eliminated from the analysis by the use of the bounds on the rate of curvature.

Laboratoire Mediterraneen de Recherches Thermodynamiques (France).
STUDY OF THE FLOW INSIDE MACH 4 NUMBER NOZZLE IN THE VERY LOW DENSITY WIND TUNNEL, by F. Marcel Devienne, G. M. Forestier, and J. Souquet. Technical note on Contract AF 61(514)1126. Mar 59, 15p. AFOSR TN-59-482; AD-215 735.
Order from LC mi$2.40, ph$3.30 PB 142 722

The aim of the measurements reported here has been to study the variations of the static and impact pressures inside the nozzle of the highly rarefied wind tunnel. The measurements indicate that the pressure varies in a continuous manner inside the nozzle and that the different flow regimes (slip-flow, transition and free-molecular) establish themselves gradually.

New York U. Coll. of Engineering, N. Y.
EXPLORATORY RESEARCH ON THE THEORETICAL CONSIDERATION OF WASTE WATER CYCLES IN A CLOSED ECOLOGICAL SYSTEM, by William T. Ingram, Bernard Newman and others. Rept. on Contract AF 18(603)71. [1959] 16p. 9 refs. AFOSR TN-59-87; AD-210 087.
Order from LC mi$2.40, ph$3.30 PB 142 540

The probable wastes may be classified to include feces, urine, sebaceous gland excretions, perspiration, respiratory end products, washings containing soil from clothing, and washings containing food particles as a result of food preparation and service.

Stanford U., Calif.
THE HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF A WAVY FIN, A STRIP FIN, AND A PERFORATED FIN HEAT TRANSFER SURFACE, by W. M. Kays. Technical rept. no. 39 on Contract Nonr-225(23). 31 Oct 58, 41p. 5 refs. AD-207 662.
Order from LC Mi$3.30, ph$7.80 PB 142 631

Basic heat transfer and flow friction characteristics of three compact high-performance heat exchanger surfaces are presented. Two of the configurations, a

strip fin surface and a wavy fin surface, are quite similar to previously tested geometries. The third is a perforated fin configuration in which the fins have been punched with 0.079 inch holes spaced 32 holes per square inch. The behavior of the strip and wavy fin surfaces is approximately as would be predicted on the basis of previously tested geometries. The perforated fin configuration is unusual, however, in that evidently a substantial increase in convection conductance has been obtained without paying a large price in terms of form drag on the fins.

Winzen Research, Inc., Minneapolis, Minn.
MANHIGH I, FLOWN BY CAPTAIN JOSEPH W. KITTINGER. June 59, 41p. AFMDC-TR-59-24; AD-215 867.
Order from LC mi$3.30, ph$7.80 PB 142 333

Operation MANHIGH I was the first of a series of manned balloon probes into the upper atmosphere, as a preliminary investigation to the Man in Space program. The structure and instrumentation of the capsule and aerostat are described, and the collected data are plotted and analyzed.

## Chemical Engineering

[Army Chemical Warfare] Labs., Army Chemical Center, Md.
AN ENZYMATIC MICRO METHOD FOR THE DETERMINATION OF ANTICHOLINESTERASES, by Joseph H. Fleisher and Harry O. Michel. May 52, declassified 27 Jan 56. 12p. 7 refs. Medical Labs. Research rept. no. 112.
Order from LC mi$2.40, ph$3.30 PB 138 963

An enzymatic method is presented by which the concentration of GB vapor in air is measured by its effect on the activity of standardized serum cholinesterase preparations. The enzymatic method appears to be the most sensitive thus far developed for the quantitative detection of GB vapor in air, since only 0.0005 mmg. GB in 0.2 ml. solution are required for an analysis. Good agreement was found between the enzymatic and fluorimetric methods on samples of chamber air collected simultaneously.

[Army Chemical Warfare] Labs, Army Chemical Center, Md.
LETHALITY OF GF AND GB VAPORS TO FRUITFLIES AND HOUSEFLIES AND A DISCUSSION OF THE Ct RELATIONSHIP, by F. M. Snyder and L. E. Chadwick. July 53 declassified 11 June 58. 28p. 33 refs. Medical Labs. Research rept. no. 201.
Order from LC mi$2.70, ph$4.80 PB 138 964

These experiments measure the dose of GF and GB vapor required to kill fruitflies and houseflies, in order to provide calibration data that would permit the use of flies in the bioassay of these agents and to compare these results with those that have been obtained with other animals.

Atlantic Research Corp., Alexandria, Va.
SURVEY OF FUNDAMENTAL KNOWLEDGE OF MECHANISMS OF ACTION OF FLAME-EXTINGUISHING AGENTS: SECOND SUPPLEMENTARY REPORT, by Raymond Friedman and Joseph B. Levy. Rept. for 25 Sep 58-10 Apr 59 on Contract AF 33(616)5569). Apr 59, 18p. 37 refs. WADC Technical rept. 56-568, Suppl. 2; AD-216 086.
Order from OTS $0.50 PB 121 853S2

This supplementary report reviews advances in the current state of knowledge of the physico-chemical means by which flames are extinguished, the period June 1958 through February 1959 being covered herein. The report includes a review of current research in relevant background areas. The bibliography contains thirty-seven references, of which the great majority refer to background work rather than direct studies of extinguishing-agent mechanisms.

## Civil Engineering

Bureau of Yards and Docks, Washington, D. C.
ADVANCED BASE FUEL STORAGE. 15 Sep 55, 149p. Technical Pub. NAVDOCKS TP-PL-17.
Order from OTS $2.75 PB 151 986

This publication presents a compilation of data on the selection of material and equipment in the Functional Component System for the construction and operation of petroleum tank farms and other petroleum facilities at advanced bases. The information presented herein should be helpful to all naval personnel concerned with planning, constructing, and operating petroleum facilities at advanced bases.

Bureau of Yards and Docks, Washington, D. C.
ARCTIC ENGINEERING. 15 Mar 55, 473p. 251 refs. Technical Pub. NAVDOCKS TP-Pw-11.
Order from OTS $6.00 PB 151 984

This publication provides guidance to Bureau and field personnel engaged in the planning, design, construction, alteration, repair, and maintenance of facilities in areas of extremely low temperatures. Chapter 1 presents general information relating to responsibilities and data for recognizing and evaluating control factors imposed by environments existent in the Cold Regions. Chapter 2 contains technical data useful in the development of engineering design for low-temperature areas. Chapter 3 presents information essential to the accomplishment of construction or development projects in the Cold Regions. Chapter 4 is devoted to the maintenance and repair facilities and engineering equipment in cold areas.

Bureau of Yards and Docks, Washington, D. C.
PETROLEUM FUELS AND LUBRICANT SYSTEMS. 1 Nov 53, 206p. 241 refs. Technical Pub. NAVDOCKS TP-Pw-7.
Order from OTS $3.50 PB 151 975

Every movement of air, surface, or underwater forces

depends for its motive power upon petroleum fuels and lubricants. The range of petroleum products required by the Navy includes practically every grade from jet-engine aircraft fuels to fleet boiler fuels. The design and construction of naval shore facilities for receiving, storing, issuing, transferring, and handling petroleum products are important functions of the Bureau of Yards and Docks. The criteria contained in this publication are intended to provide the basic technical information required by Bureau and field personnel for the design and construction of these facilities, and should facilitate a clear understanding of the requirements for facilities that will afford safe and dependable operation.

Bureau of Yards and Docks, Washington, D. C.
RAILROAD TRACKAGE. 1 Sep 52, 34p. 15 refs. Technical Pub. NAVDOCKS TP-Pw-6.
Order from OTS $1.00 PB 151 983

This publication deals primarily with the special problems that arise in the design and maintenance of rail facilities at naval establishments. Part A presents Navy policies and responsibilities, particularly those that affect this Bureau, which has primary cognizance of Navy transportation systems and equipment. The major types of such railroads are identified, and the usual methods of bearing or sharing construction costs of each type are given. Part B covers the design and construction features of trackage and details thereof for traveling cranes, as well as for standard railroads Some data also are given on the design of trestles and loading facilities. Requirements for safety appliances and warning signals are presented. Part C deals with special factors and responsibilities involved in the maintenance of Navy railroad trackage, roadbeds, ballast, drainage, and other essential elements of the rail system and related structures. The bibliography includes the outstanding reference works that should be available to those who require a wide knowledge of detailed engineering practice in this field.

Bureau of Yards and Docks, Washington, D. C.
SPECIAL SERVICES (WELFARE AND RECREATION) FACILITIES. 1 Sep 53, 64p. 14 refs. Technical Pub. NAVDOCKS TP-Pw-13.
Order from OTS $1.75 PB 151 980

This publication describes in some detail this Bureau's responsibility for the design, construction, and maintenance of such facilities, and the use of appropriated and nonappropriated funds for these purposes. This Bureau is particularly concerned with providing the desired facilities at a reasonable cost and at the same time holding fire and health hazards at a minimum. The information in this publication should be of value to all Civil Engineer Corps officers and personnel responsible for constructing and maintaining such facilities.

Bureau of Yards and Docks, Washington, D. C.
STORAGE FACILITIES. 1 Aug 53, 72p. 3 refs. Technical Pub. NAVDOCKS TP-Pw-16.
Order from OTS $2.00 PB 151 985

This publication presents data, policies, and practices designed to assure uniformity for all naval storage facilities. These criteria provide the basic technical information required by Civil Engineer Corps officers, civilian personnel, and architectural-engineering contractors concerned with providing functional storage facilities to serve the Navy in its world-wide activities.

Moran, Proctor, Mueser and Rutledge, New York.
STUDY OF DEEP SOIL STABILIZATION BY VERTICAL SAND DRAINS. Rept. on Contract NOy-88812. June 58, 468p. 35 refs.
Order from OTS $6.00 PB 151 692

Contents:
Part 1. Introduction
Part 2. Theory of consolidation by sand drains
Part 3. Soil properties affecting desing of sand drain installations
Part 4. Analyses of existing vertical sand drain installations
Part 5. Conclusions and recommendations
App. 1. Nomenclature
App. 2. Case history data
App. 3. Guide specifications

## Electrical and Electronic Engineering

Aerohautical Electronic and Electrical Lab., Naval Air Development Center, Johnsville, Pa.
THE EFFECT OF RADIO INTERFERENCE IN AIRBORNE ELECTRONICS, by C. S. Vasaka. 1 Feb 55, 20p. 5 refs. Rept. no. NADC-EL-N54144.
Order from LC mi$2.40, ph$3.30 PB 142 670

Aeronautical Electronic and Electrical Lab., Naval Air Development Center, Johnsville, Pa.
RADIO INTERFERENCE EVALUATION OF RADIO TRANSMITTING SET AN/ART-13. Phase rept. no. 1 on TED Proj. no. ADC EL-9010.8. 23 Jan 57, 15p. 4 refs. Rept. no. NADC-EL-L56108.
Order from LC mi$2.40, ph$3.30 PB 142 671

Air Force Cambridge Research Center, Bedford, Mass.
AN L-BAND CAVITY-COUPLED AMPLIFIER, by Thomas D. Coe. July 58, 29p. AFCRC-TR-58-165; AD-152 456.
Order from LC mi$2.70, ph$4.80 PB 142 380

The optimizing of between-stage coupling is a major problem in the design and operation of cascaded microwave triode amplifiers. A further problem arises in matching the tube-to-line impedance since most amplifiers in this category use coaxial cavities. These problems are eliminated by using a cavity-coupled amplifier incorporating a frequency multiplier, a mixer, and three stages of amplification (the last by means of a push-push amplifier), designed to operate with the anode and cathode resonant circuits of successive stages in the same single "ridge waveguide" cavity. No frequency-sensitive intercavity coupling devices are required. A capacitive tuning screw in the cavity tunes both the anode-grid and the

cathode-grid circuits, and the type 2C39 triodes that are used throughout need only one adjustment each. The gain per stage is 10 db at 1250 mc. The power output at a 0.002 duty cycle is 2 kw peak. A further advantage of this design is a substantial reduction in physical size over that of comparable conventional amplifiers.

Air Force Cambridge Research Center, Bedford, Mass.
SPURIOUS ECHOES ON RADAR, A SURVEY, by Vernon G. Plank. May 59, 61p. 126 refs. Geophysical Research Papers no. 62; AFCRC-TR-59-210; AD-215 470.
Order from OTS $1.75 PB 151 952

Radar echoes that are received from a sensibly clear atmosphere are commonly called "angels." In this Paper the various types are described and the probable causes discussed. Also considered is the nature of signals from extraterrestrial sources.

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MICROWAVE CAVITY DETECTOR FOR RADIATION, by Thomas D. Soapes. Master's thesis. Mar 59, 51p. 20 refs. GNE 59-16.
Order from LC mi$3.60, ph$9.30 PB 142 483

The effect of $10^5$r/hr Cobalt-60 gammas on a resonating microwave cavity is determined by the observation of the change of the cavity Q. It is shown theoretically and experimentally that the Q of a gas filled cavity decreases when the device is exposed to ionizing radiation. Due to the error introduced by the applied measurement technique, the author was unable to make quantitative comparisons of the changes of Q for different dose rates. Possible alternate techniques of observing the effect of gamma radiation on a microwave cavity are discussed.

Airborne Instruments Lab., Mineola, N. Y.
APPLICATION OF SEMICONDUCTOR DIODES TO MICROWAVE LOW-NOISE AMPLIFIERS AND HARMONIC GENERATORS, by R. Gardner, J. C. Greene and others. Quarterly progress rept. no. 1, 30 June-30 Sep 58, on Contract DA 36-039-sc-78161. 15 Oct 58. 82p. 11 refs. Rept. no. 5872-I-1.
Order from LC mi$4.80, ph$13.80 PB 142 625

The use of the nonlinear reactance of a reverse-biased P-N junction diode as a low-noise difference-frequency amplifier is analyzed in detail for one- and two-port configurations, and for the one-port degenerate configuration. Experimental results obtained on low-frequency prototype models of a one-port degenerate amplifier and a traveling-wave amplifier, as well as on a one-port 400-Mc amplifier are described.

Airborne Instruments Lab., Mineola, N. Y.
APPLICATION OF SEMICONDUCTOR DIODES TO MICROWAVE LOW-NOISE AMPLIFIERS AND HARMONIC GENERATORS, by J. C. Greene, P. P. Lombardo and others. Quarterly progress rept. no. 2, 1 Oct-31 Dec 58, on Contract DA 36-039-sc-78161. 15 Jan 59, 54p. 7 refs. Rept. no. 5872-I-2.
Order from LC mi$3.60, ph$9.30 PB 142 622

The basic performance of one- and two-port negative conductance amplifiers operated with an output stage consisting of an ideal isolator is analyzed in detail. In particular, the effect of the isolator on amplifier gain, bandwidth, and noise temperature is considered. The available power gain of a reactance amplifier in which impedances are present at both the sum and difference frequencies is analyzed in detail. A method is then outlined for computing the bandwidth of such an amplifier for any particular case. (See also PB 142 625)

Airtronic Research, Inc., Washington, D. C.
DESIGN AND DEVELOPMENT OF A MAGNETIC MULTIPLIER, by J. W. Goodwin. Final rept. on Contract NOrd-12222. 18 Apr 52, 6p. AD-159 113.
Order from LC mi$1.80, ph$1.80 PB 139 247

Antenna Lab., Ohio State U. Research Foundation, Columbus.
BANDWIDTH OF THE UNIFORM HELICAL ANTENNA, by T. S. M. Maclean and R. G. Kouyoumjian. Rept. on Contract DA 36-039-sc-70174. 31 Mar 59, 24p. 6 refs. Rept. 662-27.
Order from LC mi$2.70, ph$4.80 PB 142 748

Applied Mathematics and Statistics Lab., Stanford U., Calif.
DIFFRACTION BY AN APERTURE AT HIGH FREQUENCIES, by Harold Levine and Tai Tsun Wu. Technical rept. no. 71 on Contract Nonr-225(11). 18 Dec 57, 66p. 6 refs. AD-150 515.
Order from LC mi$3.90, ph$10.80 PB 139 392

Corrections to the geometrical transmission coefficient of a circular aperture are investigated for normal and oblique incidence. The results are compared to those of J. B. Keller (J. App. Phys. 28:426, 1957). The results for oblique incidence differ from those of Keller and are not applicable when the incident wave direction is close to that of the aperture normal. These formulas can be generalized to apply for other aperture shapes, and some results are presented for an elliptic aperture at normal incidence. A different screen boundary condition is also considered. The time harmonic problem of diffraction by an aperture in a plane screen is formulated mathematically. The problem of the circular aperture is approached as follows: the formulation is based on the integral equation for the normal derivative of the wave function on the shadow face of the screen. Specific equations are given for normal and oblique incidence. The equations are approximated through an asymptotic evaluation of the integrals; leading terms are retained, and the solution is that appropriate to the half-plane. Higher order corrections are determined by an iteration procedure. There is a natural separation of terms into various groups with an optical path associated with each group of terms. Basically the difference between these results and those of Keller is due to his failure to properly account for the higher order contribution in the singly and doubly diffracted rays.

Army Signal [Research and Development] Lab., Fort Monmouth, N. J.
ANTENNA AT-726( )/VR, by Stephen Schwed. Mar 57, 28p. Engineering rept. E-1200.
Order from LC mi$2.70, ph$4.80 PB 142 571

The results of tests indicate that the electrical characteristics of the plastic Antenna AT-726( )/VR are equal to Antenna AT-129( )/VR or AT-532 presently used. However from a mechanical and environmental aspect the plastic Antenna AT-726( )/VR is far superior to the Antenna AT-129( )/VR, or AT-532. In addition the plastic reinforced antenna affords personnel greater protection against electrical shock hazards.

Army Signal Research and Development Lab., Fort Monmouth, N. J.
A HIGH-GAIN SINGLE TRIODE 400-MEGACYCLE MIXER OSCILLATOR, by Robert W. Callinan. 20 Oct 58, 19p. 1 ref. USASRDL Technical rept. 1991.
Order from LC mi$2.40, ph$3.30 PB 142 536

This report describes work being done towards extending the frequency-operating range of a single-type triode mixer oscillator from around 100 mc and below to 400 mc to permit its use as part of a superheterodyne radiosonde receiver. Evaluation tests of breadboard models of the circuit showed satisfactory operation at 400 mc. A power gain of 1.9 db through the unit was obtained. Test procedures used and various problems encountered are explained, and circuit schematics, bridge diagrams, and associated information are included.

Ballistic Research Labs., Aberdeen Proving Ground, Md.
DOVAP ANTENNAS FOR PRE-IGY, by K. A. Richer. July 57, 62p. 11 refs. Memo. rept. no. 1087.
Order from LC mi$3.90, ph$10.80 PB 139 243

The following report describes the design and installation of various ground and airborne antennas used with the Pre-IGY DOVAP system. The DOVAP system was installed at Fort Churchill, Canada to instrument rockets for upper atmosphere research as part of the International Geophysical Year effort. A brief description of the DOVAP system and data is included. In addition, environmental factors are described.

Barnes Engineering Co., Stamford, Conn.
THERMISTOR INFRARED DETECTORS. PART I. PROPERTIES AND DEVELOPMENTS, by Russell DeWaard and Eric M. Wormser. Rept. for 1952-1958. 30 Apr 58, 130p. 13 refs. NAVORD 5495.
Order from OTS $2.75 PB 151 767

Part I, surveys the state of the art of thermistor infrared detectors and compares these detectors to other thermal and photoconductive infrared detectors. It surveys improvements in the properties of thermistor infrared detectors accomplished during the period 1952 to 1957 at Barnes Engineering Company. First efforts were concerned with developing techniques for producing thermistor infrared detectors with minimum noise level. Other early efforts concerned themselves with eliminating "swish noise", a type of noise caused by vibration of gas in the detector capsule when subjected to mechanical vibrations. The greatest development effort has been applied and the most significant advances have, however, occurred in the fundamental detector properties of time constant and responsivity, which combine to determine "detectivity". A significant advance in thermistor detector technology is a new manufacturing process employing "printing" techniques. The "printing" technique lends itself to mass production of thermistor detectors of a given size or pattern, once the requisite tooling has been accomplished. It is expected that in the future detectors of uniformly high quality can be produced by this process at a greatly reduced cost.

Bell Telephone Labs., Whippany, N. J
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 2, 13 Oct 56-12 Feb 57, on Contract DA 36-039-sc-73078. 12 Feb 57, 26p. Rept. no. 27480A; AD-132 730
Order from LC mi$2.70, ph$4.80 PB 142 635

Some design details and experimental data are given for a 100-kc GT crystal unit with an improved mounting structure, a -18° X-cut crystal unit, and a 100-kc GT unit with deposited platinum coatings to which wire attachments can be directly soldered. Resistance data at low temperatures are included for a 5-mc overtone crystal unit. Descriptions are given of a transmission line of low thermal conductivity and low capacitance, a low-current test oscillator, a special oven and oven control circuit, and a frequency comparison system expected to have an accuracy of one part per hundred billion.

Bell Telephone Labs., Whippany, N. J.
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 3, 13 Jan-12 Arp 57, on Contract DA 36-039-sc-73078. 26 May 57, 35p. Rept. no. 27480-B; AD-138 640.
Order from LC mi$3.00, ph$6.30 PB 142 636

Data and characteristics are presented for the 100-kc GT and -18° X-cut 100-kc crystal units prepared and submitted for aging evaluation at the Bureau of Standards. Results of studies of resistance and frequency variation of high-frequency AT crystal units over a wide range of temperature are given for third, fifth, seventh, and ninth overtones. These results are analyzed to separate the effects of unwanted resonances and of internal friction on Q. Q values of over 50 million are reported. Close agreement is reported between the theoretically predicted results and the actual experimental measurements made on single-stage and three-stage Pierce oscillators at 100 kc to determine the effect of component variation on frequency shift. (See also PB 142 635)

Bell Telephone Labs., Whippany, N. J.
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 4, 13 Apr-12 July 57, on Contract DA 36-039-sc-73078. 18 July 58, 35p. Rept. no. 27480-C; AD-143 592.
Order from LC mi$3.00, ph$6.30 PB 142 637

Work on 100-kc and 200-kc GT crystal units and on -18° X-cut 100-kc units is summarized. Results on

four models of 10-mc units, seventh and ninth overtones, are given. Tests on 2.5-mc AT units at liquid helium temperature and 5-mc BT units at liquid nitrogen temperature are described; work on 5-mc 20-mm units and 5-mc 15-mm AT and BT units is reviewed. Transistor properties at very low temperatures analyzed and experimental results are given. A phase-measuring method for precise comparison of frequency employing photographic recording of an intensity-modulated oscilloscope trace is described. Optimized design data for three-stage and five-stage 100-kc oscillators is also provided. (See also PB 142 636)

Bell Telephone Labs., Whippany, N. J
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 5, 13 July-12 Oct 57, on Contract DA 36-039-sc-73078. 25 Oct 57, 43p. Rept. no. 27480-D.
Order from LC mi$3.30, ph$7.80 PB 142 638

Major portions of this report deal with performance of 10-mc seventh overtone crystal units at 4.2°K, an evaluation of frequency comparison equipment used in the tests, and an analysis of factors affecting stability of the 10-mc oscillator. Further measurements are reported on transistor characteristics at 4.2°K using three different methods of measurement. Analysis of the results shows that input-output characteristics are influenced by temperature changes of a few degrees. Phase shift characteristics of transistors for use in a 2.5-mc oscillator and their variation with collector voltage, base current, and temperature are related to observed frequency changes in an experimental oscillator. Brief report is made on performance of two 2.5-mc oscillators of Rome III design operating at about 48°C. (See also PB 142 637)

Bell Telephone Labs., Whippany, N. J.
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 6, 13 Oct 57-12 Jan 58 on Contract DA 36-309-sc-73078. 22 Jan 58, 30p. Rept. no. 27480-E.
Order from LC mi$2.70, ph$4.80 PB 142 639

Major portions of this report deal with results of aging and current tests of 10-mc seventh overtone crystal units of 4.2°K, preliminary performance data on a 2.5-mc crystal unit at 18°C, measurements of phase changes in transistors as a function of operating parameters, evaluations of single- and two-stage crystal-controlled transistor oscillators, and results of tests on thermo-compression method for attachment of mounting wires to crystal plates. Analysis is also made of relative merits and problems to be solved for operation of 10-mc AT crystal unit at 4.2°K and 2.5-mc crystal in range of 0°C to 25°C. Evaluation is made of relative advantages and disadvantages of transistor oscillators for a high-frequency standard. (See also PB 142 638)

Bell Telephone Labs., Whippany, N. J.
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 7, 13 Jan-12 Apr 58, on Contract DA 36-039-sc-73078. 5 May 58, 42p. Rept. no. 27480-F.
Order from LC mi$3.30, ph$7.80 PB 142 640

This report covers work on 100-kc crystal units with thermo-compression wire attachments for which improved resistance-temperature characteristics are reported, the results of tests for the frequency dependence on amplitude for 10-mc AT crystal units at 4.2°K, and results of measurements to determine the angular control required for 2.5-mc units having zero coefficient near room temperature. An improved 100-kc oscillator circuit is described which has increased stability and a lower noise figure than previously obtained. Important improvements are reported in the design of a new 2.5-mc three-stage oscillator. The final circuit is improved by at least one order of magnitude over the single-stage 2.5-mc oscillator in sensitivity to filament voltage. Frequency comparisons for the new oscillator are shown relative to the Whippany Frequency Standard. An Appendix contains an analysis which partially explains the dependence of resonant frequency on crystal current. (See also PB 142 639)

Bell Telephone Labs., Inc., Whippany, N. J.
AN ULTRA-PRECISE STANDARD OF FREQUENCY, by R. A. Sykes. Interim rept. no. 8, 13 Apr-12 July 58, on Contract DA 36-039-sc-73078. 7 Aug 58, 35p. Rept. no. 27480-G.
Order from LC mi$3.00, ph$6.30 PB 142 641

This report includes the results of short-time aging tests on 100-kc thermo-compression bonded crystal units, of tests on a 10-mc fifth overtone AT crystal unit having improved frequency stability with current and shock at 4.2°K, and of further investigations on the frequency-temperature characteristics of overtone BT crystal units. A description is given of the technique used for thermo-compression bonding nickel ribbon supports to a 2.5-mc crystal plate. A new vacuum system for frequency adjustment by vapor plating is described in which substantial improvement has been obtained in pumping time and bake-out properties. A multiplier chain and modulator for frequency comparison at 40 mc is reported on briefly. Extensive experimental data is presented relating to stability studies on two experimental 2.5-mc multistage oscillators comparing the performance of three types of pentode tubes. Effects of variation of filament voltage, plate voltage, and suppressor and control grid bias are shown. (See also PB 142 640)

Bureau of Yards and Docks, Washington, D. C.
ADVANCED BASE ELECTRICAL AND COMMUNICATION SYSTEMS. 1 Sep 56, 65p. 12 refs. Technical Pub. NAVDOCKS TP-PL-15; BUDOCKSINST 4040.7.
Order from OTS $1.75 PB 151 981

This publication has been prepared as a guide for naval personnel responsible for the planning and installation of lighting, power generation and distribution systems, and wire communication systems at advanced bases. It should also be helpful to personnel responsible for the operation of electric and wire communication systems. Materials and methods are described and criteria are established for the installation of electric power and wire communication systems.

California Inst. of Tech. [Pasadena].
DESIGN AND CONSTRUCTION OF EQUIPMENT USED TO OPERATE A COMMERCIAL POWER LINE AS A VERY LOW FREQUENCY ANTENNA, by R. M. Golden, R. V. Langmuir and others. Technical rept. no. 3 on Contract AF 18(600)1552. 1 Oct 58, 27p. 5 refs. AFOSR TN-58-908; AD-204 514.
Order from LC mi$2.70, ph$4.80 PB 139 319

Clevite Transistor Products, Waltham, Mass.
RESEARCH AND DEVELOPMENT OF GERMANIUM PNP JUNCTION SWITCHING TRANSISTORS, by Paul L. Meretsky. Quarterly progress rept. no. 2, 10 Sep-9 Dec 58, on Contract DA 36-039-sc-75060. [1958] 24p
Order from LC mi$2.70, ph$4.80 PB 142 760

Germanium PNP power transistors of .5°C/watt thermal resistance, HFE current gain of 20 minimum at collector currents of 25 amperes with saturation resistance of 20 milliohms maximum, rise, fall, and storage times of 15, 7, and 15, respectively, have been constructed.

Collins Radio Co., Cedar Rapids, Iowa.
DEVELOPMENT OF A TRANSISTORIZED PORTABLE FREQUENCY STANDARD, by R. L. Craiglow and J. P. Frederichs. Final engineering rept. for 9 July 56-1 Nov 57 on Contract DA 36-039-sc-73030. [1957] 59p. 17 refs. Rept. no. CER-791; AD-155 293.
Order from LC mi$3.60, ph$9.30 PB 142 632

This report covers the development of a portable frequency standard utilizing a change-of-state oven for temperature control of a 5-mc quartz crystal. The crystal oscillator, buffer, and output stages are transistorized and powered by self-contained mercury batteries. Everything but the power source for the change-of-state oven heater is contained in a module with nominal dimensions of 3-1/2" x 4-1/2" x 6" and a total volume of 94-1/2 cubic inches.

Collins Radio Co., Cedar Rapids, Iowa.
SINGLE-SIDEBAND COMMUNICATIONS SYSTEM. Quarterly rept. no. 10, 15 Jan-15 Apr 58, on Contract AF 30(635)4504. 15 Apr 58, 81p. Interim development rept. 395-32; RADC-TN-58-241; AD-148 894.
Order from LC mi$4.80, ph$13.80 PB 139 346

This project has been established for the purpose of planning, developing and demonstrating for Air Force use, a flexible single-sideband communications system which will provide reliable communications over long distances in ground-to-air, air-to-ground, and point-to-point service. (See also PB 135 701)

Collins Radio Co., Cedar Rapids, Iowa.
SINGLE-SIDEBAND COMMUNICATIONS SYSTEMS. Quarterly interim development rept. no. 11, 15 Apr-15 July 58, on Contract AF 30(635)4504. 15 July 58, 74p. 7 refs. IDR-395-35; RADC-TN-58-327; AD-205 921.
Order from LC mi$4.50, ph$12.30 PB 142 589

The final ARC-58 radios were delivered. The field performance of this design fulfilled the requirements. The major items remaining to be completed for the ground stations are the directional antennas and the transmitter/receiver control. In both cases, the designs were completed. Efforts on the transportable systems are showing rapid progress.

Columbia U. School of Electrical Engineering, New York.
RELIABILITY STUDY OF COMMUNICATION SYSTEMS, by Omar Wing. Technical rept. T-32/B on Contract AF 18(600)677. 15 Sep 58, 24p. 4 refs. CU-50-58-AF-677-EE; AFOSR TN-58-890; AD-204 139.
Order from LC mi$2.70, ph$4.80 PB 139 409

This report presents a new method of analysis of the reliability of a communication system. The method makes use of the matrix method of the theory of linear graphs. The system under consideration consists of a number of communication stations connected by links. Associated with each link is a probability of failure. The problem is to express the probability of failure of the overall system in terms of some of the topological properties of the graph which represents the system. In this way, a connection is established between some quantitative measure on one hand and the structure of the graph on the other. To this end, a new matrix in the theory of linear graphs has to be introduced and its properties studied. These properties are derived and given in terms of a number of theorems. They include (1) a relation between the path matrix and the vertex matrix, (2) the rank of the path matrix, and (3) the correspondence of a non-singular submatrices in the path matrix and the path cut sets. The probability of failure then is expressed in terms of the path matrix and is in fact given by the probability of the union of the "basis-cut-set products."

Columbia U. School of Engineering, New York.
ON PERIODICITY OF STATES IN LINEAR MODULAR SEQUENTIAL CIRCUITS, by Bernard Friedland. Technical rept. T-33/B on Contract AF 18(600)677. 15 Sep 58, 21p. 7 refs. CU 51-58-AF-677-EE; AFOSR-TN-58-907; AD-204 515.
Order from LC mi$2.70, ph$4.80 PB 139 406

The state periodicity of unexcited, linear modular sequential circuits characterized by the vector-matrix equation $s(n+1) - A\,s(n)$ over GF(p) is considered by application of Galois field theory. It is shown that if the minimal polynomial $m'(x)$ of A of degree k' is irreducible, the set of all matrix polynomials in A of degree k' form a Galois field isomorphic to GF $[p, m'(\eta)]$, and consequently that the state period is equal to the period (order) of the subgroup generated by $\eta$ in GF $[p, m'(\eta)]$. If the minimal polynomial is reducible, it is shown that the matrix period is the least common multiple of the periods generated by $\eta$ in GF $[p, m_i(\eta)]$ where $m_i(x)$ are the irreducible factors of the characteristic polynomial of A, and that every state period is a divisor of the matrix period.

David Sarnoff Research Center, Princeton, N. J.
INVESTIGATION AND STUDY OF PRACTICAL UTILIZATION OF MOLECULAR ABSORPTION PHENOMENA FOR FREQUENCY CONTROL, by L. E. Norton.

Quarterly rept. nos. 1-7, 1 May 52-28 Feb 54, on Contract DA 36-039-sc-15525. 7 nos.
Order from LC

Quarterly rept. no. 1, 1 May-31 July 52, 26p. mi$2.70, ph$4.80, PB 142 651
Quarterly rept. no. 2, 1 Aug-31 Oct 52, 22p. mi$2.70, ph$4.80, PB 142 652
Quarterly rept. no. 3, 1 Nov 52-31 Jan 53, 28p. mi$2.70, ph$4.80, PB 142 653
Quarterly rept. no. 4, 1 Feb-30 Apr 53, 35p. mi$3.00, ph$6.30, PB 142 654
Quarterly rept. no. 5, 1 May-31 Aug 53, 34p. mi$3.00, ph$6.30, PB 142 655
Quarterly rept. no. 6, 1 Sep-30 Nov 53, 17p. mi$2.40, ph$3.30, PB 142 656
Quarterly rept. no. 7, 1 Dec 53-28 Feb 54, 43p. mi$3.30, ph$7.80, PB 142 657

David Sarnoff Research Center, Princeton, N. J.
INVESTIGATION AND STUDY OF PRACTICAL UTILIZATION OF MOLECULAR ABSORPTION PHENOMENA FOR FREQUENCY CONTROL, by L. E. Norton. Quarterly rept. no. 9, 1 June-31 Aug 54, on Contract DA 36-039-sc-15525. 10 Sep 54, 15p. 9 refs.
Order from LC mi$2.40, ph$3.30 PB 142 658

As the result of an extensive series of tests, both the special cell and "electronic" portions were disassembled, modified and repaired, and reassembled. The system is again ready for operation. (See also PB 142 651)

Diamond Ordnance Fuze Labs., Washington, D. C.
COMPACT FERRITE DUPLEXER-DETECTOR, by R. Van Wolfe and J. C. Cacheris. 1 June 59, 16p. 10 refs. TR-712.
Order from LC mi$2.40, ph$3.30 PB 142 847

A duplexer-detector has been build that has the advantages of small size, few component parts, no external circuitry, and at least 35-db receiver isolation over a frequency range greater than 200 mc. Use of this duplexer-detector should greatly simplify many microwave systems.

Diamond Ordnance Fuze Labs., Washington, D. C.
EFFECT OF TEMPERATURE ON ALPHA AND ALPHA CUTOFF, by Edwin Hirshmann. 17 Apr 59, 25p. 4 refs. TR-662.
Order from LC mi$2.70, ph$4.80 PB 142 852

Effect of ambient temperature on the transistor parameters alpha and alpha cutoff at various bias conditions. The alpha decreases and the alpha-cutoff frequency increases with a lowering of the ambient temperature.

Eitel-McCullough, Inc., San Bruno, Calif.
METAL-CERAMIC RECEIVING TUBES FOR AUTOMATIC PRODUCTION, by William H. Sain. Rept. for 15 Apr 52-27 Aug 57 on Electronic Tubes and Transistors, Contract AF 33(600)17125. Apr 59, 67p. WADC Technical rept. 58-426; AD-214 260.
Order from OTS $1.75 PB 151 919

The first five types of a line of ceramic receiving tubes have been developed. These are suitable for operation where superior performance under extreme environmental conditions is desired. They utilize stacked planar electrodes to facilitate automation of assembly and processing operations. A program of investigation of ceramic metalizing and brazing processes is described. Functional models of automatic production and assembly machines were constructed. The CD-16 served as the prototype for the succeeding tubes in the line. These included the CD-18 sharp cutoff pentode, the CD-19 triode, and the CD-22 beam power triode. Samples of the CD-19 and CD-22 operated for more than 100 hours at an environmental temperature of 500°C. The preliminary designs of three additional tube types, the CD-24 and CD-26 twin triodes and the CD-25 twin diode, are presented.

Electrical Engineering Research Lab., U. of Illinois, Urbana.
SYNTHESIS OF A COMMUNICATION NETWORK, by Wataru Mayeda. Interim technical rept. no. 15 on Contract DA 11-022-ORD-1983. 20 Mar 59, 23p. 4 refs.
Order from LC mi$2.70, ph$4.80 PB 142 720

A method of synthesis of an information network (known also as a communication net) from a given terminal capacity matrix is presented. This method is accomplished by introducing a new matrix called a "branch capacity matrix" and by knowing the relationship between this matrix and a terminal capacity matrix.

Electrical Testing Labs., Inc., New York.
$NH_3$ GETTER FOR MOLECULAR BEAM OSCILLATOR, by F. Fua, B. A. Schroeder, and A. Alotta. Quarterly progress rept. no. 1, July-Sep 56, on Contract DA 36-039-sc-72808. 31 Oct 56, 43p. 54 refs.
Order from LC mi$3.30, ph$7.80 PB 142 715

A preliminary report on the results of a theoretical and experimental investigation into methods of maintaining a high vacuum inside a chamber having a continuous influx of ammonia gas is presented. The following developments have been reported: (1) a method for eliminating from consideration inadequate materials by means of a short-term discriminatory test; (2) two alternative experimental procedures for measuring adsorption isotherms; and (3) a list of 39 substances for consideration as ammonia adsorbents.

Electrical Testing Labs., Inc., New York.
$NH_3$ GETTER FOR A MOLECULAR BEAM OSCILLATOR, by Frederic Fua. Quarterly progress rept. no. 2, Oct-Dec 56, on Contract DA 36-039-sc-72808. 31 Jan 57, 18p. 6 refs.
Order from LC mi$2.40, ph$3.30 PB 142 716

The following developments are reported: (1) consideration of ionic pumping in the light of a review of known work in this field; (2) consideration of continuous circulation of $NH_3$ between source and vacuum chamber; and (3) the acquisition and assembly of apparatus for rapid discriminatory tests of potential $NH_3$ gettering materials by the gravimetric method based on using a quartz balance. (See also PB 142 715)

Electrical Testing Labs., Inc., New York.
$NH_3$ GETTER FOR A MOLECULAR BEAM OSCILLATOR, by Frederic Fua. Progress rept. no. 3, Jan-Mar 57, on Contract DA 36-039-sc-72808. [1957] 18p. 24 refs. AD-140 246.
Order from LC mi$2.40, ph$3.30 PB 142 717

The following results are reported: (1) further review and analysis of the literature pertaining to potential $NH_3$-gettering substances, including palladium and palladium black; (2) absorption of $NH_3$ (ionic pumping) by ionization-type gauge used in the measurement of the vacuum in a closed system; and (3) results of a series of tests using a quartz balance to determine the gettering of $NH_3$ by activated charcoal at ambient temperature and down to -30°C. (See also PB 142 716)

Electron Tube Lab., U. of Michigan, Ann Arbor.
ANALYSIS OF NONLINEAR O-TYPE BACKWARD-WAVE OSCILLATORS, by Joseph E. Rowe. Technical rept. no. 25 on Contract AF 30(602)1845. June 58, 44p. 19 refs. UMRI rept. 2750-3-T; RADC-TR-58-93; AD-148 806.
Order from LC mi$3.30, ph$7.80 PB 142 565

The linear, large-C O-type backward-wave oscillator equations are formulated in this report and their solutions discussed. The nonlinear traveling-wave tube equations have been modified to permit the analysis of O-type backward-wave oscillator operation in the large-C region. These equations have been solved for large values of C including the effect of space charge. The start-oscillation conditions are determined by assuming values of circuit voltage at the gun end and electron velocity and integrating the nonlinear equations until the circuit voltage is zero. The start-oscillation condition may occur at the first or subsequent minima in the r-f voltage. Nonzero minima in the r-f voltage vs. distance correspond to backward-wave amplifier operation. The results of the above calculations give the operating efficiency and necessary device length CN as functions of the design parameters, including the stream current $I_o$. The theoretical predictions of efficiency agree well with published experimental data.

Electron Tube Research Lab., U. of Minnesota, Minneapolis.
DIFFUSION AND INTERFACE STUDIES ON CATHODE SLEEVE NICKEL, by W. G. Shepherd. Quarterly rept. no. 19, 1 July-1 Oct 57, on Contract NObsr-63172. 1957, 102p. 7 refs. AD-200 300.
Order from LC mi$5.70, ph$16.80 PB 142 464

An investigation of the saturation emission from an oxide coated cathode and the rate of reduction of the coating, on a 4.5% Ti-Ni base. An investigation of the electrical leakage which develops between electrodes supported by an insulating surface when this surface is exposed to evaporation products from a cathode based on a high magnesium-nickel alloy.

Electronics Research Lab., U. of California, Berkeley.
THE ANALYSIS AND COMPENSATION OF NONLINEAR SAMPLED-DATA FEEDBACK SYSTEMS, by F. J. Mullin. Rept. on Contract AF 18(600)1521. 22 Aug 58, 132p. 29 refs. Series no. 60, issue no. 211; AFOSR TN-58-825; AD-202 910.
Order from LC mi$6.90, ph$21.30 PB 142 560

The major purpose of this study has been to attempt to answer some of the problems which arise in the analysis of nonlinear sampled-data systems. In particular, we have centered our attention on relay systems and saturating systems because these two nonlinearities are often encountered in sampled-data systems and we have studied the methods which appear to be applicable to the analysis of these systems. The method used to analyze the relay system was different from that developed to analyze saturating systems; the only feature common to both was that the starting point in each case was the difference equation which described the system, and since this is the fundamental description of the system, it is felt that this is the logical starting point in the analysis of nonlinear sampled-data systems.

Electronics Research Lab., U. of California, Berkeley.
BASIC RESEARCH IN MICROWAVE ELECTRONICS, by J. R. Singer, C. Süsskind and others. Annual scientific rept. for 1 Oct 57-30 Sep 58 on Contract AF 49(638)102. 31 Oct 58, 30p. 19 refs. Series no. 60, issue no. 215; AFOSR TN-58-989; AD-205 909.
Order from LC mi$2.70, ph$4.80 PB 142 564

Noise measurements are described on a backward-wave amplifier with movable gun-circuit spacing in order to study the space-charge waves in their coupling to the backward-wave circuit. Theory of the effect of a virtual cathode is discussed. Design and construction of a diode for measuring noise effects in the gun region are also described. A solid-state maser using adiabatic fast passage in irradiated magnesium oxide is described. Theories of the effect of radiation damping on the adiabatic fast passage are given. Studies on the entrance conditions into a periodic focusing system for electron beams are described, and a unified point of view toward all focusing systems.

Electronics Research Lab., U. of California, Berkeley.
EXPERIMENTAL STUDY OF CASCADE BACKWARD-WAVE MAGNETRON AMPLIFIER AT LOW LEVELS, by J. W. Kluver and G. A. Becker. Rept. on Electronic Component Sciences Research, Contract AF 33(616)3278. Jan 59, 38p. 4 refs. WADC Technical rept. 58-448; AD-204 800.
Order from OTS $1.00 PB 151 829

An experimental version of the two-circuit backward-wave magnetron amplifier is described. The low-level operation shows a dependence of the gain on beam velocity and current similar to that of the equivalent O-type device. An over-all stable gain of 10 db is easily obtained. The effect of the spread of the magnetron beam is investigated. An attempt is made to correlate the experimental results with various theoretical models for magnetron operation. One theoretical model is suggested which gives some promise in describing the interaction. Although characteristics of the present tube do not make it particularly interesting either as a small-signal or large-signal practical backward-wave amplifier, it has been very valuable in

giving information on the d-c beam model, and the character of growing waves on this beam. Since recommendations are given for design modifications to make a more practical tube for application purposes.

Electronics Research Lab., U. of California, Berkeley.
LAMINAR FLOW IN MAGNETICALLY FOCUSED CYLINDRICAL ELECTRON BEAMS, by J. L. Palmer. Rept. on Contract AF 49(638)102. 20 Nov 58, 28p. 14 refs. Series no. 60, issue no. 217. AFOSR-TN-58-990; AD-205 908.
Order from LC mi$2.70, ph$4.80 PB 139 340

The behavior of a cylindrical electron beam in a magnetic field is discussed in terms of a laminar-flow model. By numerical integration of the equations of motion the maximum and minimum radii of excursion and the wave length of the undulations for each electron are presented in graphical form for various boundary conditions on the electron beam. By the proper selection of the boundary conditions, e.g., magnetic field strength at the cathode, the graphs are utilized to decribe Brillouin flow, space-charge-balanced flow, immersed flow, confined flow, and, in fact, any electron flow which satisfies the laminar flow criterion. The perturbations introduced by improper injection conditions for any of the flows mentioned can be read directly from the graphs. A study of the wavelength and the amplitude of such perturbations as a function of radial position in the beam determines if a given type of flow with given injection conditions satisfies the laminar flow criterion. The sensitivity of the various types of electron flow to misadjustments of the boundary conditions is clearly revealed by the graphs, e.g., the amplitude of the undulations in Brillouin flow is very sensitive to the adjustment of the magnetic field strength, whereas, for immersed flow a similar deviation in magnetic field strength has very little effect on the amplitude of the undulations.

Electronics Research Lab., U. of California, Berkeley.
QUARTERLY PROGRESS REPORT. Rept. for 1 Oct-31 Dec 57 on Contract N7onr-29529. 15 Jan 58, 16p. 3 refs. Series no. 60, issue no. 19.
Order from LC mi$2.40, ph$3.30 PB 139 325

Contents:
Diffraction of plane waves by a circular aperture in a thin infinite plane conductor
Backscattering cross-section of oblate spheroids
Arrays of single mode slots in multimode waveguide
Microwave radiometry
Stripline between curved boundaries
Frequency independent antennas
Network theory
Transistor circuit research
A study of nonlinear control systems

F-R Machine Works, Inc., Woodside, N. Y.
THE DEVELOPMENT OF SIGNAL GENERATOR AN/URM-92 (XW-2). Final engineering rept. for Mar 57-Jan 58 on Contract AF 30(602)1425. 10 Mar 58, 19p. RADC-TR-58-36; AD-148 651.
Order from LC mi$2.40, ph$3.30 PB 142 650

The changes incorporated in the (XW-2) model due to evaluation of the (XW-1) model are explained. Recommendations and final test data are also enclosed.

General Electric Co., Owensboro, Ky.
ELECTRON TUBE BULB TEMPERATURE RATINGS, by Monte W. Edwards. Rept. on Electronic Tubes and Transistors, Contract AF 33(600)32562. Jan 59, 76p. WADC Technical rept. 58-523; AD-204 801.
Order from OTS $2.00 PB 151 830

Perhaps the most critical operating variable associated with subminiature tubes has been bulb temperature. This project attempts to determine the reaction of three subminiature tube types 5840, 5902, and 6111 to an environment involving standard MIL specification intermittent life test conditions, with the exception that the tubes were not cycled, and were subjected to four different bulb temperatures (260C, 220C, 160C and room temperature). Final results have lead to the following conclusions: Maximum bulb temperature should not exceed 220C. A temperature of 260C will result in excessive shrinkage. Maintenance of bulb temperature at 160C will result in excellent reliability out to 2500 hours of life. Data indicate folded heaters to be superior to coil heaters. Bulb ionization plays an important part in a tube's ability to withstand high ambient rise.

General Electric Co., Schenectady, N. Y.
EVALUATION OF UHF PLANAR TRIODE TUBE TYPE 6897 IN THE POSITIVE GRID REGION, by E. B. Gempler. Final rept. for 15 Mar-15 Dec 58 on Contract DA 36-039-sc-74837. [1958] 34p.
Order from LC mi$3.00, ph$6.30 PB 142 769

This report describes work in evaluating UHF Planar Triode Tubes, Type 6897 in the positive grid region and for pulse emission using a long square wave pulse voltage applied to the grid. The division of current between the grid and anode was measured in the current division test and the bias necessary to obtain a designated plate current was recorded. In the long pulse test, the falling off of total cathode current during the pulse was used as the criteria of measurement. Tests were conducted with both 5.5 volts and 6.3 volts applied to the heater.

General Electric Microwave Lab., Palo Alto, Calif.
DEVELOPMENT Z-5219 100 WATT CW S-BAND TWT, by Richard H. Winkler. Rept. on Electronic Tubes and Transistors, Contract AF 33(600)35624. June 59, 44p. 1 ref. WADC Technical rept. 59-26.
Order from OTS $1.25 PB 151 958

The purpose of this program was to design, build, and deliver three traveling-wave tubes with a power output of greater than 100 watts at S-band meeting the requirements for R & D exhibit WCRE 56-59. The parallel helix provides considerable improvement over the conventional single helix tube in efficiency, voltage, length, and weight. Potentially it can be scaled to power levels perhaps an order of magnitude greater than that which is attainable with single helix tubes.

General Radio Co., Cambridge, Mass.
FREQUENCY CONTROL SYSTEMS, by R. W. Stuart. Quarterly progress rept. no. 6, 1 Nov 53-1 Feb 54, on Contract DA 36-039-sc-15542. Feb 54, 23p. 2 refs.
Order from LC mi$2.70, ph$4.80 PB 142 534

A general analysis of the phase loop is made for a system employing division of the locked oscillator frequency. The analysis includes the effect of an external signal introduced to frequency-modulate the locked oscillator. The results of the phase loop analysis are then used to establish certain design criteria for various loop components, and to set limitations on the frequency of the external modulating signal. General problems associated with the introduction of frequency modulation in the system are discussed, and ways of using the frequency synthesizer to control a separate fm modulator are briefly considered. (See also PB 139 395)

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
HIGH-TEMPERATURE INSULATION FOR WIRE, by J. N. Harris and J. D. Walton. Rept. for 1 Feb 58-31 Jan 59 on Ceramic and Cermet Materials, Contract AF 33(616)3944. July 59, 43p. 5 refs. WADC Technical rept. 58-13, Pt. 2; AD-216 362.
Order from OTS $1.25 PB 151 944

Aluminum was plated and subsequently anodized on substrates of copper, chrome, iron and Inconel. Efforts to anodize aluminum plated over various layer metals on copper were unsuccessful. Frit-silicone resin compositions were applied to anodized wire in separate steps, and electrical properties of frit-resin coatings applied to anodized wire were determined. Colloidal silica was deposited electrophoretically on anodized aluminum as a possible substitute for frit-resin coatings. Work on a "one time at temperature coating" showed possibilities of continuous operation to 900°F.

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
INVESTIGATIONS OF PRECISION FREQUENCY-CONTROL TECHNIQUES, by Robert E. Meek and Samuel N. Witt, Jr. Quarterly rept. no. 4, 1 Jan-31 Mar 56, on Contract DA 36-039-sc-64597. [1956] 39p. 1 ref.
Order from LC mi$3.00, ph$6.30 PB 139 432

Only slight improvement appeared in the results of runs on Invar cavity-oscillators during long-term measurements as compared to similar runs of the previous quarter. Room temperature runs on Invar and Stupalith cavity-oscillators produced greatly improved results compared to the results for an Invar cavity-oscillator operated under similar conditions during the previous quarter. Some causes of low sensitivity and thus low resolution in the short-term frequency-stability measuring system are discussed. (See also PB 139 088)

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
INVESTIGATIONS OF PRECISION FREQUENCY-CONTROL TECHNIQUES, by Robert E. Meek and Samuel N. Witt, Jr. Quarterly rept. no. 5, 1 Apr-31 May 56 on Contract DA 36-039-sc-64597. [1956] 16p.
Order from LC mi$2.40, ph$3.30 PB 139 433

Work has continued on the short-term frequency stability system to improve its sensitivity and resolution. A 12-db, 600-mc cavity amplifier was constructed to assure an input voltage of 5 v to the discriminator. Preliminary tests reveal that the mixer is now capable of detecting a 100-microvolt signal applied to the discriminator system. More recent measurements on the UHF coaxial ring transformer reveal 48-db terminal isolation between the input and output arms at the center frequency, and a 3-db band width of 60 mc. (See also PB 139 432)

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
STUDY OF AGING EFFECTS OF QUARTZ CRYSTAL PLATES, by R. B. Belser and Mercer D. Carithers. Quarterly rept. no. 1, 1 Aug-31 Oct 57, on Contract DA 36-039-sc-74946. [1957] 32p.
Order from LC mi$3.00, ph$6.30 PB 142 619

In order to determine the effect of the frequency adjustment step on the stabilities of 16.5 mc plated AT-cut quartz resonators, 40 units have been adjusted and their frequencies measured at constant temperatures over periods of 60 to 90 days. The relatively poor stability observed appears to be related to a predominant use of reclaimed blanks and containers. Twenty resonators coated on both sides simultaneously by evaporation of aluminum onto the hot quartz (450°C) did not prove stable.

Horizons, Inc., Cleveland, Ohio.
THERMOELECTRIC GENERATORS, by Lloyd Owens. Final rept. for 7 Feb-1 Dec 57 on Contract AF 30(602)1634. 10 Jan 58, 65p. 6 refs. RADC-TR-58-26; AD-148 618.
Order from LC mi$3.90, ph$10.80 PB 142 578

This project covers experimental engineering investigation leading to the construction of five breadboard thermoelectric generators. The maximum efficiency achieved was 1.47% at a load of 2.6 volts with a 10 watt-15 cubic centimeter heat source. A method of improving commercial insulating materials was found. The design parameters governing the choice of the number of junctions apportionment of heat flow, temperature difference and internal resistance in their relationship to efficiency was studied.

Hughes Aircraft Co., Culver City, Calif.
S-BAND LOW-NOISE BACKWARD-WAVE AMPLIFIER, by W. W. Mueller. Quarterly progress rept. no. 5, 1 July-30 Sep 58, on Contract DA 36-039-sc-74908. [1958] 16p. 4 refs.
Order from LC mi$2.40, ph$3.30 PB 142 767

Density-function calculations of noise propagation in beams having the type of potential profile and initial velocity distribution which exist in the Hughes low-noise electron gun have been initiated. Because the tube developed thus far (PAS-2) satisfies the objective specifications initially established, the recent effort

has been directed toward extending the low-noise tuning range and solving problems of ruggedization and of minimizing size and power requirements. Performance data for a second coupled-helix tube are presented. Initial experiments with glazed-helix structures have demonstrated a tube noise figure as low as 2.9 db and a noise figure less than 8 db over almost an entire octave. The results of detailed calculations of possible focusing by electrostatic and periodic magnetic fields are discussed, and an initial experimental balun for use with a bifilar helix is described. (See also PB 140 247)

Hunt Corp., Carlisle, Pa.
DESIGN AND DEVELOPMENT OF IMPROVED METHODS OF MOUNTING AND ATTACHING SUPPORT WIRES TO LOW FREQUENCY RESONATORS, by Richard E. Ca laman. Quarterly progress rept. no. 1, 1 June - 31 Aug 56, on Contract DA 36-039-sc-72791. [1956] 16p. 1 ref.
Order from LC mi$2.40, ph$3.30 PB 142 644

The requirement for quartz crystal units operating at frequencies below 500 kc/sec is increasing, and the precision required is becoming greater. The present standard maximum temperature at which crystal units must maintain specified performance is 80°C; however, current requirements make it necessary to increase this limit to 100°C. Future applications of oven-controlled units will probably increase the temperature requirements to 200°. These requirements for greater precision at higher operating temperatures cannot be met using the present technique of soft soldering the mounting wire to a fired silver spot an the quartz plate. The research and development involves analytical and experimental investigation of mounting methods and materials. It is expected that this investigation will provide optimum mounting techniques and suitable material to be utilized in establishing design data for crystal units possessing greater precision and operating at increased temperatures.

Hunt Corp., Carlisle, Pa.
DESIGN AND DEVELOPMENT OF IMPROVED METHODS OF MOUNTING AND ATTACHING SUPPORT WIRES TO LOW FREQUENCY RESONATORS, by Richard E. Calaman. Quarterly progress rept. no. 2, 1 Sep - 30 Nov 56, on Contract DA 36-039-sc-72791. [1956] 15p. 1 ref.
Order from LC mi$2.40, ph$3.30 PB 142 645

The research and development involves analytical and experimental investigation of mounting methods and materials. It is expected that this investigation will provide optimum mounting techniques and suitable material to be utilized in establishing design data for quarts crystal units possessing greater precision and operating at increased temperatures. (See also PB 142 644)

Hunt Corp., Carlisle, Pa.
DESIGN AND DEVELOPMENT OF IMPROVED METHODS OF MOUNTING AND ATTACHING SUPPORT WIRES TO LOW FREQUENCY RESONATORS, by Richard E. Calaman. Progress rept. no. 3 1 Dec 56 - 30 June 57, on Contract DA 36-039-sc-72791 [1957] 14p. 2 refs. AD-139 140.
Order from LC mi$2.40, ph$3.30 PB 142 647

The requirement for quartz crystal units operating at frequencies below 500 kc/sec is increasing, and the precision required is becoming greater. The present standard maximum temperature at which crystal units must maintain specified performance is 80°C; however, current requirements make it necessary to increase this limit to 100°C. Future applications of oven-controlled units will probably increase the temperature requirements to 200°. These requirements for greater precision at higher operating temperatures cannot be met using the present technique of soft soldering the mounting wire to a fired silver spot on the quartz plate. The research and development involves analytical and experimental investigation of mounting methods and materials. It is expected that this investigation will provide optimum mounting techniques and suitable material to be utilized in establishing design data for crystal units possessing greater precision and operating at increased temperatures.

Hunt Corp., Carlisle, Pa.
DESIGN AND DEVELOPMENT OF IMPROVED METHODS OF MOUNTING AND ATTACHING SUPPORT WIRES TO LOW FREQUENCY RESONATORS, by Richard E. Calaman. Progress rept. no. 4, 1 July - 31 Aug 57, on Contract DA 36-039-sc-72791. [1957] 9p. 4 refs. AD-146 690.
Order from LC mi$1.80, ph$1.80 PB 142 646

The work during the fourth progress period involved improvement of the hole drilling techniques. The drill and drill holder for the sonic equipment were modified. Mechanical mountings employing mechanical joints between the crystal plate and the mounting filament were investigated. Glass solders were further tested. High temperature solders for sealing the unit were explored. Some crystal units were assembled using materials previously tested. (See also PB 142 647)

Illinois U., Urbana.
HIGH-TEMPERATURE ELECTRICAL INSULATING INORGANIC COATINGS ON WIRE, by Clifton G. Bergeron, Arthur L. Friedberg and others. Rept. for Feb 58-Jan 59 on Electrical and Electronic Materials, Contract AF 33(616)3943. June 59, 56p. 3 refs. WADC Technical rept. 58-12, Pt. 2; AD-214 700.
Order from OTS $1.50 PB 151 943

Further work on processing of coatings, coating continuity, multiple coating, formulation of coatings, oxidation of copper coated articles, high temperature electrical properties of coatings, and flexibility of coated wire are described. The technique of flow coating continuously moving wire through a procelain enamel proved to be a practicable and successful technique for coating. Multiple coating secured insulation continuity. It was shown from studies on oxidation of coated copper specimens that copper oxide dissolved in the coating is not deleterious but rather beneficial to the high temperature electrical properties.

Inland Testing Labs., Morton Grove, Ill.
CAPACITORS, FIXED, VITREOUS ENAMEL DIELECTRIC, by Joseph J. Bingenheimer. Final rept. for 1 July 57-1 May 58 on Contract DA 36-039-sc-73232. [1958] 52p. AD-161 720.
Order from LC mi$3.60, ph$9.30 PB 142 475

During the task assignment, 448 vitreous enamel capacitors were procured from one specified manufacturer and subjected to evaluation tests in accordance with a test procedure approval by USASESA. A summarization of the results of each test is included herein and forms Appendix A of this report. Based on the results obtained during the test program, specification requirements were determined for vitreous enamel capacitors and a separate procurement specification recommended for these capacitors. A recommended procurement specification has been prepared and is included herein as Appendix D of this report.

Inland Testing Labs., Morton Grove, Ill.
TRANSISTORS, EFFECTS OF COMBINED ENVIRONMENTAL EXPOSURES ON, by Bernard T. Marren. Final rept. for 1 Jan-30 Apr 58 on Standardization Study, Contract DA 36-039-sc-73232. [1958] 39p. 2 refs. Test rept. no. 10527; AD-161 722.
Order from LC mi$3.00, ph$6.30 PB 142 461

This standardization study is concerned with evaluating the effects of the following combined environments on the physical and electrical properties of four specified types of transistors: (1) high temperature vibration, (2) high temperature shock, (3) high temperature acceleration, (4) low temperature vibration, (5) low temperature shock, and (6) low temperature accleration. In order to accomplish this objective, the study was divided into five phases of work. This report covers all phases of the study. During the task assignment, 600 transistors were procured and subjected to evaluation tests in accordance with a test procedure approved by USASESA. A summarization of the results of each test is included herein and forms Appendix A of this report. As a result of this study program, recommendations have been prepared for including combined environmental testing in the applicable military specification.

Laboratory of Aviation Psychology, Ohio State U. Research Foundation, Columbus.
THE EFFECT OF PROCEDURAL VARIATIONS IN THE USE OF TARGET IDENTIFICATION AND AIRBORNE POSITION INFORMATION EQUIPMENT ON THE PERFORMANCE OF A SIMULATED RADAR APPROACH CONTROL SYSTEM, by Robert G. Kinkade and J. S. Kidd. Rept. on Contract AF 33(616)3612; continuation of Contract AF 33(616)43. May 59, 25p. 9 refs. WADC Technical rept. 58-624.
Order from OTS $0.75 PB 151 957

Two experimental steps were employed to evaluate the interaction effects of airborne position information equipment and continuous target identification in a simulated radar approach control task. Several variations in the procedures and system configuration were also compared. Ten laboratory-trained controllers participated. The results led to the conclusion that some of the functional characteristics of API and target ID are interchangeable in that API provides an independent method of target identification. Ground reference points and fixed approach paths employed as possible aids in the use of the API facility proved to interfere with the flexibility of operations.

Lansdale Tube Co., Pa.
DIFFUSED-BASE R. F. POWER OSCILLATOR JUNCTION TRANSISTORS, by J. A. Hastings. Quarterly progress rept. no. 2, 1 Oct-31 Dec 58, on Contract DA 36-039-sc-78051. [1958] 38p.
Order from LC mi$3.00, ph$6.30 PB 142 763

A new mounting method has been designed and put into use. The ring mount of the original device has been replaced by a sub-stem. The new mounting method had necessitated a number of changes in the fabrication process. The new operations are described in detail.

Lincoln Lab., Mass. Inst. of Tech., Lexington.
PARABOLIC-CYLINDER REFLECTOR PATTERNS, by R. L. Pease. Rept. on Contract AF 19(122)458. 13 Nov 57, 15p. 6 refs. Technical rept. no. 167; AD-110 029.
Order from LC mi$2.40, ph$3.30 PB 142 519

An explicit expression is obtained in series form for the principal plane pattern of a parabolic-cylinder reflector fed by a line source at the focus; the off-axis quadratic phase term, neglected in the plane-aperture approximation, is here taken into consideration. For uniform illumination, the side-lobe structure of the plane-aperture approximation is supplemented by an out-of-phase field of nearly uniform amplitude approximately $1/4ka$ times that of the main lobe, where $k = 2\pi/\lambda$ and a is the focal length. If the illumination is tapered, the magnitude of the supplementary side-lobe structure decreases in about the same manner as that of the side lobes in the plane-aperture approximation.

Massachusetts Inst. of Tech., Cambridge.
A SECOND ORDER ACTIVE FILTER, by Richard D. Smallwood. Bachelor's thesis. Rept. on Contract AF 04(645)09. June 57, 65p. 10 refs. T-131; AD-151 711.
Order from LC mi$3.90, ph$10.80 PB 142 675

The purpose of this study is to design a second order filter whose natural frequency can be varied without changing the damping ratio. The filter will be used to eliminate noise in a system in which the frequency components of the recorded output are calculated to within one per cent by means of a Fourier analysis. Included in the analysis of the system are the effects of the phase shift and transient response of the filter on the Fourier analysis of the output. Compensating equations are derived for these effects in terms of the filter zero frequency gain, natural frequency, and damping ratio.

Michigan U. [Research Inst.] Ann Arbor.
OVERMODULATION OF A CARRIER BY SINE WAVE AND GAUSSIAN NOISE, by D. R. Rothschild. Technical rept. no. 75 on Contract DA 36-039-sc-63203. Sep 57, 28p. 6 refs. 2262-169-T; AD-151 918.
Order from LC mi$2.70, ph$4.80 PB 142 521

This paper discusses all degrees of amplitude modulation of a carrier by sine wave and Gaussian noise. The analysis is based on formulation of a basic model of an a-m transmitter and an idealized modulation characteristic. Appropriate parameters are defined to characterize the degree of modulation, including overmodulation. The increase in r-f power due to modulation is calculated and is shown to approach 3 decibels for complete overmodulation, for which modulation by a square wave is the limiting case. The effect of clipping of the modulating wave form is discussed. The peak-to-rms voltage ratio of the modulated r-f wave as a function of the degree of modulation is determined. It is shown that this ratio is not a satisfactory measure of the amount of modulation, and that the modulation parameters defined herein are a much better specification of the degree of modulation.

Michigan U. [Research Inst.] Ann Arbor.
SYNTHESIS OF LOSSLESS NETWORKS FOR PRESCRIBED TRANSFER IMPEDANCE BETWEEN SEVERAL CURRENT SOURCES AND A SINGLE RESISTIVE LOAD, by A. B. MacNee. Technical rept. no. 76 on Contract DA 36-039-sc-63203. Nov 57, 21p. 7 refs. 2262-171-T; AD-151 917.
Order from LC mi$2.70, ph$4.80 PB 142 522

A technique is presented for the synthesis of lossless networks open-circuited at one end and paralleled across a single resistance at the other end. The synthesis is for prescribed transfer impedances between the open-circuited terminals and the resistive termination. Such networks can be applied to a variety of frequency multiplexing problems, including the design of multi-channel amplifiers. Examples are included, and some practical limitations of such networks are considered.

Microwave Associates, Inc., Burlington, Mass.
DEVELOPMENT OF DIODE TYPE 50649B, by R. B. Collins and R. P. Rafuse. Quarterly progress rept. no. 2, 1 Sep-30 Nov 58, on Contract DA 36-039-sc-78021. [1958] 27p.
Order from LC mi$2.70, ph$4.80 PB 142 761

Results of the experimental determination of proper ceramic material and internal geometry of the diode are reported. The status and performance of the overall receiver noise figure test equipment are discussed. (See also PB 140 250)

Microwave Engineering Labs., Inc., Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS, by Wesley P. Ayres and Perry H. Vartanian. Quarterly progress rept. no. 6, 3 Aug-1 Nov 58, on Contract DA 36-039-sc-73278. [1958] 28p. 7 refs.
Order from LC mi$2.70, ph$4.80 PB 142 626

Second harmonic output from a ferrite harmonic generator has been studied as a function of sample size for the half-disk geometry. For different materails the optimum size is different. Two modified semi-static mode amplifier structures have been designed. (See also PB 138 832)

Microwave Engineering Labs., Inc., Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS, by Wesley P. Ayres and Perry H. Vartanian. Quarterly progress rept. no. 7, 2 Nov 58-31 Jan 59, on Contract DA 36-039-sc-73278. [1959] 26p. 5 refs.
Order from LC mi$2.70, ph$4.80 PB 142 766

Analysis which includes loss and geometry factors indicates that for the uniform precession mode a thin slab of ferrite magnetized in the plane of the slab should be the best geometry for harmonic generation at millimeter wavelengths. An analysis of the modified semi-static mode of amplification in ferrites gives a relation for the pump frequency power required for oscillation at the signal frequency. This type of amplifier has been operated and oscillates at a pump power of 18 kw which is in reasonable agreement with the predictions. As an amplifier a gain of 30 db with a bandwidth of 9 mc at 7215 mc was achieved. Garnet single crystals of small size have been grown. (See also PB 142 626)

Microwave Physics Lab., Sylvania Electric Products, Inc., Mountain View, Calif.
HIGH POWER MICROWAVE SWITCH, by S. J. Tetenbaum. Quarterly progress rept. no. 2, 16 Sep-15 Dec 58, on Development of a High Power Magnetic-Field Controlled Microwave Gas Discharge Switch Operating at S-Band, Contract DA 36-039-sc-78044. 9 Feb 59, 14p.
Order from LC mi$2.40, ph$3.30 PB 142 762

The objectives are to investigate techniques for the development, design and fabrication of a high power magnetic-field controlled gas discharge microwave switch for operation at S-band and to deliver three laboratory model switches and one electromagnet and power supply for switching control.

Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y.
THE FAR FIELDS EXCITED BY A POINT SOURCE IN A PASSIVE DISSIPATIONLESS ANISOTROPIC UNIFORM WAVEGUIDE, by A. D. Bresler. Rept. on Contract AF 19(604)2031. 24 Sep 58, 19p. 9 refs. Research rept. R-683-58; PIB-611; AFCRC TN-58-565; AD-160 877.
Order from LC mi$2.40, ph$3.30 PB 139 420

The direction of the net power flow associated with a propagating mode of an arbitrary passive dissipationless anisotropic uniform waveguide may be opposite to its direction of (phase) propagation. It is shown that when a point source is introduced into a waveguide in which this is the case, such propagating modes contribute to the fields excited by this source only in that direction for which their power flow is directed away from the source. In addition it is shown that the nonpropagating modes contribute to the total field only in that direction in which they decay with increasing distance away from the source so that the far fields are given by a superposition of propagating modes only. The proof given makes use of the known properties of the frequency dependence of the physical parameters of any linear passive system in which the causality restriction is satisfied.

Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y.
THE IMPEDANCE AND FIELDS OF SOME TEM MODE TRANSMISSION LINES, by Charles A. Hachemeister. Rept. on Contract AF 19(604)2031. 16 Apr 58, 107p. 3 refs. Research rept. R-623-57; PIB-551; AFCRC-TN-58-359; AD-160 802.
Order from LC mi$5.70, ph$16.80 PB 142 435

The characteristic impedances and field distributions of a number of strip lines are obtained by conformal mapping. The solutions are divided into three categories, rectangular lines having essentially two conductors, rectangular lines having essentially three conductors, and lines whose cross sections are circular.

Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y.
REPRESENTATION THEORY OF LINEAR PASSIVE NETWORKS, by Dante C. Youla. Rept. on Contract AF 30(602)1709. 20 May 58, 55p. 8 refs. Research rept. R-655-58; PIB-583; RADC-TN-58-188; AD-148 810.
Order from LC mi$3.60, ph$9.30 PB 142 648

A theoretical investigation of the properties of the most general linear, passive n-port is undertaken. Representation theorems for both scattering and positive-real nxn matrices (reciprocal or not) are derived.

Motorola, Inc., Chicago, Ill.
LOW FREQUENCY ELECTRO-MECHANICAL FILTERS, by B. Niederman and Stanley P. Lapin. Quarterly progress rept. no. 1, 1 May-31 July 52, on Contract DA 36-039-sc-15535. [1952] 35p.
Order from LC mi$3.00, ph$6.30 PB 142 535

Theoretical developments of the equations of vibration for aeolotropic materials in thickness shear and in extensional modes, and for isotropic plates in extensional modes, are made. Examples of frequency determining curves and of deformation shapes are given. A discussion of the remaining steps in the design of desirable electro-mechanical filters is given.

Motorola, Inc., Chicago, Ill.
NONTACTICAL RADIO EQUIPMENT SYSTEM STUDY, by Francis R. Steel, George J. Niman, and Charles E. Lloyd (Rome Air Development Center). Final engineering rept. on Contract AF 30(602)1251. 1 Nov 57, 359p. 29 refs. RADC-TR-58-48; AD-148 674.
Order from LC mi$11.10, ph$54.60 PB 142 494

The detail factual data of the report is divided into 15 sections which deal with theory and measurements of VHF wave propagation, antenna characteristics, noise, interference, equipment life and maintenance, improvements, visits to Air Force bases and tests of portable sets.

Naval Avionics Facility, Indianapolis, Ind.
MATRICES AND LINEAR TRANSFORMATIONS WITH APPLICATIONS TO THE ANALYSIS OF ELECTRIC CIRCUITS AND SYNCHROS, by James B. Ward (Purdue U.) 15 June 57, 101p. 26 refs. NAFI-TP-16.
Order from LC mi$5.70, ph$16.80 PB 142 495

Certain definitions, properties, and theorems regarding matrices and determinants are presented here as a necessary preliminary to the formulation of electric circuit and synchro performance equations in matrix notation. In general, properties and theorems are presented without proofs. Attempts have been made to illustrate various points through simple examples so that the reader can gain some familiarity with the notation and the mechanics of matrix operations as a convenient tool. Those interested in pursuing further study of the formal theory of matrices can find many good references on the subject, some of which are listed in the bibliography.

Naval Research Lab., Washington, D. C.
THERMOELECTRICITY ABSTRACTS. May 59, 104p. 620 refs.
Order from OTS $2.50 PB 151 657

This bibliography represents the accumulation of unclassified references to the literature on thermoelectric research, development, and application resulting from a search of abstract journals, indexes and bibliographies immediately accessible. Some early as well as current material is included. Additional bibliographies will be issued at intervals, the objective being to attain as complete coverage of the literature as possible. Arrangement for periodical entries is alphabetical - by author, or by title if author is lacking; and for research reports by issuing agency. Each entry is numbered in preparation for an anticipated index. Abbreviations for journal titles are based on those used by the U. S. Naval Research Laboratory Library. A list of these abbreviations together with the journals which they represent appears on the pages following this introduction. The majority of the journals and books referred to should be available for consultation or borrowing at the larger public or research libraries. Research reports can usually be obtained through established borrowing procedures from the Armed Services Technical Information Agency and the Office of Technical Services. AD and PB numbers are included when known.

New York U. Coll. of Engineering, N. Y.
EVALUATION AND OPTIMIZATION OF DIGITAL COMMUNICATION SYSTEMS, by S. S. L. Chang, B. Harris and others. Final scientific rept. for 14 Jan 58-14 Jan 59 on Contract AF 19(604)1964. 14 Feb 59, 27p. 24 refs. AFCRC-TR-59-110; AD-211 102.
Order from LC mi$2.70, ph$4.80 PB 142 381

The work under this contract on the evaluation of digital communication systems and their optimization under practical criteria and constraints is summarized. This work includes: an analysis of the the effects of noise in the feedback channel of communication systems; a general theory of digital communication systems with fading, interference, and feedback; the extension of null-zone reception to systems employing envelope detection of a pulsed carrier, including FSK; and the performance of an experimental null-zone reception system with unidirectional and decision-feedback channels. Suggestions for future research investigations are given.

New York U. Coll. of Engineering, N. Y.
THEORY OF THE CAVITY MICROWAVE SPECTROMETER AND MOLECULAR FREQUENCY STANDARD, by Yardley Beers. Rept. on Contracts AF 49(638)259 and Nonr-285(35). 12 Sep 58, 18p. 13 refs. AFOSR TN-58-871; AD-203 714.
Order from LC mi$2.40, ph$3.30 PB 139 410

A short section of a wave guide is considered as a non-resonant absorption cell and then as a resonant cavity. It is shown that the latter gives a better signal-to-noise ratio by a factor which depends upon the relative intensity of the various noise sources but which increases with the Q. It is shown that the voltage signal-to-noise ratio is proportional to the square root of the product of the volume and the Q and otherwise is independent of the shape. This result leads to the conclusion that it is possible in theory to buidl microwave spectrometers having signal-to-noise ratios some 50 db larger or capable of detecting absorption coefficients some 300 times smaller than spectrometers which are now widely used. However, practical considerations probably would prevent all of this advantage from being realized. These results are applied to a frequency standard using an absorption line. It is shown that it is possible to build a standard using the 3, 3 line of $NH_3$ with a fractional stability of about $4 \times 10^{-12}$ over an extended interval of time. Some discussion of spectrometers with long non-resonant cells is included also.

Notre Dame U., Ind.
ANALYSIS OF ELECTRICAL NON-LINEAR ELEMENTS AND CIRCUITS, by Harold E. Ellithorn and Robert C. McCollum. Rept. on Electronic Component Sciences Research, Contract AF 33(616)3445. Apr 59, 96p. 397 refs. WADC Technical rept. 58-339; AD-213 790.
Order from OTS $2.25 PB 151 916

Two methods of obtaining the response of a R L C circuit containing a non-linear inductor to an arbitrary applied voltage are discussed. One method makes use of the phase portrait of the circuit; the other, of the $\phi$-i relationship for the inductor. A method of evaluating the coefficients in a polynomial approximation to the two paths of a hysteresis loop is presented. This evaluation is made from a set of tuned voltmeter readings. A RLC circuit with nonlinear resistance is analyzed in a novel manner. A bibliography of material related to nonlinear circuits is presented.

Pacific Semiconductors, Inc., Culver City, Calif.
INTRINSIC-BARRIER TRANSISTOR TECHNIQUES (SILICON), by J. L. Buie, J. Cohen and others. Quarterly rept. no. 5, 15 July-15 Oct 58, on Contract DA 36-039-sc-74887. [1958] 26p. 2 refs. PSI Rept. no. 3000:15-14-Q.
Order from LC mi$2.70, ph$4.80 PB 142 754

The requirements for a 300 mw, 400 mc oscillator transistor are stated and new techniques for making the small geometry are outlined.

Pacific Semiconductors, Inc., Culver City, Calif.
INTRINSIC-BARRIER TRANSISTOR TECHNIQUES (SILICON), by J. L. Buie and W. E. Roach. Quarterly rept. no. 6, 15 Oct 58 - 15 Jan 59, on Contract DA 36-039-sc-74887. [1959] 38p. 5 refs. PSI rept. no. 3000: 15-17-Q.
Order from LC mi$3.00, ph$6.30 PB 142 768

The effect of emitter stripe width on performance of the VHF intrinsic barrier silicon transistor is analyzed. Additional design criteria are also discussed. These results indicate that a relizable design may be expected to yield an $f_{max}$ between 520 and 825 mcps, which should be adequate for attainment of the objective specification of 30% oscillator efficiency at 400 mcps. Characterization methods are being improved, and measurement facilities and test circuits expanded to permit increasingly complete and accurate measurement of the parameters and performance of the units being produced.

Pacific Semiconductors, Inc., Culver City, Calif.
VARIABLE CAPACITOR DIODES, by L. S. Chase and H. D. Frazier. Quarterly progress rept. no. 3, 1 Oct-31 Dec 58, on Contract DA 36-039-sc-75044. [1958] 32p.
Order from LC mi$3.00, ph$6.30 PB 142 771

Alternative processes for the n and p+ regions of the hypersensitive type voltage variable capacitor are discussed. Units fabircated using one such process have shown hypersensitivity between -7 and -10 volts. Based on the improvement of capacitance range, nominal capacitance, and figure of merit, the abrupt junction device having $V^{-1/2}$ voltage sensitivity of capacitance is proposed as the best candidate for satisfaction of electronic tuning requirements. Characteristics of sample units produced to date are presented. Progress in characterization and measurement is outlined. Next quarters activities are to be aimed at further device and process improvement in terms of electronic tuning, and the fabrication of "developmental model" units in partial satisfaction of Item 2 of the contract.

Philco Corp., Philadelphia, Pa.
IMPROVED K-BAND SEMICONDUCTOR MIXER DIODE, by William L. Barnes, Basil V. Lawson, and Charles Wood. Rept. for 1 May 57-30 Nov 58 on Electronic Tubes and Transistors, Contract AF 33(616)5354. June 59, 97p. 2 refs. WADC Technical rept. 59-83; AD-210 229.
Order from OTS $2.25 PB 151 970

Gallium-arsenide diodes have been made which have a very low noise figure at 10, 16, and 24 KMC. In addition these diodes operate up to 300°C without damage. The frequency response of gallium-arsenide diodes is flat within 2 db over a temperature range of 20° to 300°C, which is a considerable improvement over germanium or silicon. Since the beginning of this research, gallium-arsenide metallurgy has been developed to a point where it is now pure enough to use for diode crystals. Gallium arsenide has proven to be a stable compound, and apparatus has been adapted to purify this compound and also to purify the two elements prior to reaction. The conditions which promote the growth of single crystals have been established. Gallium arsenide was chosen after exploring the adaptability of many other intermetallics. Its high

mobility permits an increase in diode frequency response over that of silicon and germanium diodes, and its high-band gap promotes high temperature operation. A suitable internal geometry has been adapted to diodes employing this compound and a fabrication process has been developed. Problems in fabrication such as crystal-to-stud bonding, optimum whisker shape, and whisker contact radius have been solved. Fifty sample diodes have been manufactured.

Radio Corp. of America, Harrison, N. J.
ELECTRON TUBE, 26.5 VOLT REMOTE-CUTOFF PENTODE AMPLIFIER, RECEIVING TYPE, by J. L. Gutowski. Final rept. for 1 Apr 57-30 June 58 on Contract DA 36-039-sc-73185. 15 Sep 58, 72p. 1 ref.
Order from LC mi$4.50, ph$12.30 PB 142 743

Progress is reported for work accomplished on the following phases: (1) Background study and evaluation of existing tube and test equipment. Several alternative techniques for measuring cross-modulation are discussed. (2) Design of a tube having an improved cross-modulation response characteristic. The objective of developing a tube with an exponential transfer characteristic to reduce cross-modulation distortion is explained. (3) Production of contract tube samples and preparation of proposed specification. Data on the final tubes supplied under the contract are tabulated along with life and mechanical test results. Average characteristics curves, electrical characteristics histograms, and a proposed specification based on the final samples of the developmental A-4908-F (commercial 26FZ6) are presented.

Rensselaer Polytechnic Inst., Troy, N. Y.
SIMILAR UNIFORM COLLINEAR ARRAYS AND MULTIPLE RECEIVER CORRELATION, by Melvin J. Jacobson. Rept. on Contract Nonr-591(09). 15 July 57, 36p. 4 refs. RPI MathRep no. 9; AD-140 376.
Order from LC mi$3.00, ph$6.30 PB 142 462

This report is concerned with the nature of the mean output of a single correlator receiving system when the input is a narrow frequency band signal arising from a localized source in space. The signal is received by two uniform, collinear arrays having an equal number of omni-directional receivers. The mean output as a function of steering is bounded by the product of the space factors of the two arrays, so that the gross nature of the mean can be determined by investigating the main lobe width and side lobe level of the space factor product. These two quantities are studied as functions of the number of receivers, the receiver spacing, signal frequency, and source direction.

Rome Air Development Center, Griffiss AFB, N. Y.
RADAR EVALUATION BY MEANS OF AERIAL PHOTOGRAPHY, by Donald M. Montana. Nov 58, 25p. 2 refs. RADC-TR-58-124; AD-202 091.
Order from LC mi$2.70, ph$4.80 PB 142 686

Much has been said concerning the capability of determining the space position of a target through the use of ground radar and the accuracy to which this position can be defined. To this end it would seem necessary to be able to evaluate this capability throughout the effective range of the radar. Various methods have been employed with limitations in the scope of the coverage of the test instrumentation. This report attempts to present a method having maximum flexibility and requiring a minimum of expense. The principles described include vertical aerial photogrammetry and the Church Direction Cosine Method of tilt analysis. It is recommended that personnel responsible for the evaluation of ground radar equipments consider this report a practical tool to serve their future needs.

Rome Air Development Center, Griffiss AFB, N. Y.
RELIABILITY REQUIREMENTS FOR GROUND ELECTRONIC EQUIPMENT (DEVELOPMENT AND SERVICE TEST). 31 Oct 58, 9p. Exhibit RADC-2629.
Order from LC mi$1.80, ph$1.80 PB 142 463

Shoup Engineering Co. [Chicago, Ill.]
BROADBAND RECORDING EQUIPMENT, by R. A. Bierwirth, C. M. Minor and T. P. Cooper. Final rept. for 1 Oct 54-15 June 56 on Contract DA 36-039-sc-64515. [1956] 36p. AD-149 305.
Order from LC mi$3.00, ph$6.30 PB 142 744

The Factual Data Section is divided into two parts, one treating the work done on the equipment to improve it mechanically, the other part covers the work done in the attempt to make the required tests. The mechanical changes that were made were necessary in order to improve the tape tracking, to reduce tape flutter, to reduce the excessive noise of the rotor, and to provide protection to the operator from the rapidly moving parts. New tape guides, pressure pads, and pressure roller assemblies, were constructed. The electronics of the motor speed control system which maintains the lateral position of the tape on playback in synchronism with its position on recording were studied and improvements were made. A study was made of the effect of wear of the contact surface of the rotor signal heads. Tests were also made on the operation of the slip ring system which feeds the signal from the rotating heads to the amplifiers.

Sonotone Corp., Elmsford, N. Y.
STUDY OF SEALED NICKEL-CADMIUM BATTERIES, by Irwin M. Schulman. Quarterly rept. no. 1, 1 Dec 58-28 Feb 59, on Contract DA 36-039-sc-78249. [1959] 48p.
Order from LC mi$3.30, ph$7.80 PB 142 721

The experimental program was divided into 2 main tasks. The first task includes a development and evaluation of Sonotone hermetically sealed nickel cadmium batteries. The second task includes a study of the reaction mechanism and kinetics of a hermetically sealed cell. Experiments have been designed and initiated for 2 phases of Task I and also for Task II. A cycling panel was constructed for life cycling studies on hermetically sealed cells. A reaction chamber was designed for the reaction mechanism study. Preliminary investigations were made at 1/2 atmosphere and 1 atmosphere pressures on the effects of the variations of volume and concentration of electrolyte on cell performance. This work indicates that an increase in electrolyte concentration gives increased capacity and decreased voltage level.

Stanford Research Inst., Menlo Park, Calif.
INVESTIGATION OF METHODS OF SCANNING THE BEAM OF LARGE ANTENNAS, by E. M. T. Jones and J. S. Honda. Scientific rept. no. 7, 1 Dec 58 - 28 Feb 59, on Contract AF 19(604)2240. Mar 59, 32p. 8 refs. AFCRC TN-59-196; AD-215 827.
Order from LC mi$3.00, ph$6.30 PB 142 468

A brief outline is presented of some of the factors that affect radar range. A reduction in the noise figure of the radar receiver can greatly increase the radar range, especially if the antenna is pointing at the cold sky. An analysis is also presented of the diode up-converter, a new type of low-noise solid-state amplifier that converts upward in frequency and that is particularly suitable for use with electronic scanning antennas. The gain of the three-frequency up-converter is considerably greater than of the two-frequency up-converter, while its noise figure is only slightly higher. When the three-frequency up-converter is connected in series with a down-converter in the usual fashion, the over-all noise figure of the combination can be lower than if a two-frequency up-converter were used.

Tennessee U. Engineering Experiment Station, Knoxville.
AN AMPLITUDE SCANNED CIRCULAR ARRAY, by H. P. Neff, W. T. Patton and others. Final rept. on Contract AF 19(604)1557. 31 Oct 58, 56p. 3 refs. AFCRC TR-58-195; AD-160 881.
Order from LC mi$3.60, ph$9.30 PB 139 293

In this report a circular antenna array is described which forms a directional beam that can be pointed to any desired azimuth angle. The antenna consists of several rings of dipoles which are stacked vertically. Each ring produces a term in the far-field pattern of the form $\cos k\phi$, and the entire pattern is of the form $\sum_{k=0}^{K} A_k \cos k\phi$ where K is the number of rings. The phase is the same for all of the currents in any one ring, and the phase difference between adjacent rings is 90°. Further, the impedance of all of the elements in any one ring is the same. These properties of the array make it possible to excite each element from a separate amplifier. All of the amplifiers exciting a particular ring are driven in phase and the amplitude of the output is controlled by a control voltage. This, in turn, controls the pointing of the beam. The design of a three-ring array is given in detail in this report. Also the design of an amplifier suitable for amplitude control is given. Experimental verification of the properties of the stacked ring array is presented.

Thompson Products, Inc., Cleveland, Ohio.
DEVELOPMENT AND FABRICATION OF HIGH POWER "S" AND "L" BAND WAVEGUIDE SWITCHES IN ACCORDANCE WITH EXHIBIT RADC-1701, by J. M. Sadler. Final engineering rept. on Contract AF 30(602)1252. 14 Sep 56, 152p. 8 refs. Rept. no. ER-3084; RADC TR-56-139; AD-97 868.
Order from LC mi$7.50, ph$24.30 PB 139 414

Development was completed on the S-and L-band switches. Both switches are of the SPDT type, where the right and left channels are diametrically opposed and the common channel is at right angles to these channels. The switches incorporate a shuttle which slides to the right or left, thus opening the left or right channel, respectively, to the common channel. At intermediate shuttle positions, the configuration of the waveguide switch is such as to provide the necessary transformer action to combine the output waveguide channels at the common channel with excellent matching at that point. The device is capable of switching under power with negligible reflection to the transmitter providing the output waveguide channels are properly matched. The top and side plates of the L-band switch as well as all the RF components of the S-band switch were machined from standard Al plate; however, the L-band corner blocks and shuttles were machined from specially forged billets of Al. Bearing surfaces of the shuttles and plates were made of hard chrome plated Al and ground to a fine finish. The actuation mechanisms of the switches are improvements on many designs which served to define those characteristics necessary for optimum switching performance and to indicate the approach whereby these characteristics can be obtained. Recommendations were made for improving the performance and producibility of the switches.

Washington U. Coll. of Engineering [Seattle].
OPTIMUM RADIATION PATTERN SYNTHESIS FOR CIRCULAR APERTURE, by Akira Ishimaru and Gedalia Held. Technical rept. no. 29 on Contract AF 19(604)4098. Oct 58, 27p. 8 refs. AFCRC-TN-58-563; AD-160 875.
Order from LC mi$2.70, ph$4.80 PB 139 274

This work presents a method of determining the source field distribution over a circular aperture in order to produce an optimum radiation pattern. The source function employed is a finite series of Bessel functions and a general form of the radiation pattern is derived with the requirement for the optimization. The optimum pattern for an aperture is carefully defined in contrast with the ordinary Dolph's optimum pattern for a linear array. Maximum and minimum numbers of terms of the source function are examined in view of the supergaining and the sidelobe level.

Washington U. Coll. of Engineering, Seattle.
SYNTHESIS OF RECTANGULAR APERTURES, by John W. Blundell, Gedalia Held, and Akira Ishimaru. Technical rept. no. 32 on Contract AF 19(604)4098. Mar 59, 74p. 15 refs. AFCRC-TN-59-147; AD-211 931.
Order from LC mi$4.50, ph$12.30 PB 142 382

The synthesis for a rectangular aperture excited by several modes is described. The synthesis of the aperture distribution considers a radiation pattern with a near optimum compromise between sidelobe level and beamwidth. Two types of patterns are considered. A single beam and two symmetrical beams which, respectively, are maximum at any predetermined angle. The synthesis procedure for both types is derived from the point of view of complex variable theory, following closely the procedure developed by T. T. Taylor for line source antennas.

Western Electric Co., Laureldale, Pa.
INDUSTRIAL PREPAREDNESS STUDY: SILICON DIODES, by R. F. Lipscomb, W. D. Boynton and P. Zuk. Quarterly progress rept. no. 9 for 1 July-30 Sep 57 on Contract DA 36-039-sc-70243. [1957] 70p. 2 refs.
Order from LC mi$3.90, ph$10.80 PB 139 434

Incorporation of an alloying process to apply to the manufacture of 4.7 volt reference diodes, evaluation of silicon material, submission of experimental samples of the 4.7 and 6.2 volt reference diodes, redesign of the internal lead, mil spec evaluation, and design and construction of additional tooling for mechanization.

Willow Run Labs., U. of Michigan, Ann Arbor.
A POSSIBLE NEW MODE OF OPERATION FOR FOUR-LEVEL MASERS, by George Makhov. Memo. on Proj. Michigan, Contract DA 36-039-sc-78801. June 59, 8p. 2 refs. Rept. no. 2900-67-R.
Order from LC mi$1.80, ph$1.80 PB 142 782

A new application of the push-pull pumping scheme is proposed, leading to maser operation with a signal frequency higher than pump frequency. Conditions are indicated under which such operation is possible, and a simple theory is developed. Experimental results obtained with a ruby maser are quoted.

Zenith Radio Corp., Chicago, Ill.
TRANSVERSE FIELD TRAVELING WAVE TUBE, by Robert Adler and George W. Hrbek. Final development rept. for 15 Feb 56-15 Nov 57 on Contract AF 30(602)1519. 25 Nov 57, 66p. 9 refs. RADC-TR-58-7; AD-148 553.
Order from LC mi$3.90, ph$10.80 PB 142 577

Efforts were directed toward improving the over-all performance of earlier transverse field TWT's by reducing their noise figure and increasing their gain to meet specifications. The RF matching of the input and output to the helices was improved by changing the electrostatic focusing field pattern of the helices. Instabilities, present because of wall charges, were eliminated. Mechanical instabilities, caused by heating effects, are still present. An attempt was made to decrease the width of a beam crossover, found to exist in the electron gun used in the earlier tubes, in order to reduce the noise contributed by the initial transverse velocities. When mechanically accurate helices were used, noise figures in the region of 5 to 6 db were measured. A search was made for a material on which longer helices could be wound to obtain additional gain. Alsimag 243 (Forsterite) was very satisfactory. Tubes were built with helices twice as long as the originals; their gains were in excess of 20 db and their noise figures were in the region of 7.5 db. An impedence matching device and a package amplifier were constructed.

## Ordnance, Missiles, and Satellite Vehicles

Aberdeen Proving Ground, Md.
TEST OF GRAPHITE COATING (ELECTROFILM PROCESS) ON BREECH MECHANISM 120MM, T123E1. Rept. no. 5 for July 54-June 55 on Ordnance Proj. no. TR3-3045. 8 Sep 55, 11p.
Order from LC mi$2.40, ph$3.30 PB 139 418

The object was to determine the effectiveness and merits of a Graphite Coating (Electrofilm Process) as a finish for 120mm Breech Mechanisms.

Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
GRAPHICAL REPRESENTATION OF RE-ENTRY TRANSFER ORBITS, by Lynn E. Wolaver. Mar 59, 72p. 8 refs. WADC Technical note 59-141; AD-214 761.
Order from OTS $2.00 PB 151 938

This report represents an analysis of two-dimensional transfer orbits between a circular orbit in a vacuum above a spherical Earth and a point on that rotating Earth. These re-entry orbits are characterized by two parameters, e, the eccentricity and, p, the semi-latus rectum. The report presents constant loci lines in this e-p plane; these are modified Vertregt diagrams. The loci considered consist of re-entry angle, re-entry velocity, retro-thrust required, retro-thrust alignment angle, time-to-impact, range to impact, target lead angle at application of retro-thrust, and target-satellite angle at impact. Both the direct and apogee routes are considered. Superposition of several graphs may be used to determine such things as: the minimum time-to-impact at a safe re-entry angle and re-entry velocity for a given maximum available retro-thrust; the minimum retro-thrust required to permit re-entry at some given re-entry angle and velocity; the decrease in time to impact that can be realized by doubling the retro-thrust capability; etc. Numerous other combinations are possible.

Air Force Missile Development Center, Holloman AFB, N. Mex.
HOLLOMAN TRACK CAPABILITIES, by Teddie G. Ashmore, Apr 59, 80p. 4 refs. AFMDC-TR-59-14; AD-212 717.
Order from LC mi$4.50, ph$12.30 PB 142 375

Because the Holloman Track can closely simulate missile free flight environment and allow closer observation during and after a run, it is an ideal development facility for use between laboratory and free flight tests of guidance and other systems. The Holloman track is the longest and most precisely aligned test track in the world. The design and construction was based on experience gained at Holloman and the other major tracks. Track testing has been in progress here since 1949, when the SNARK missile was tested. Since this time, dozens of unique and varied programs have been successfully accomplished, building a valuable reservoir of experience.

Air Force Missile Development Center, Holloman AFB, N. Mex.
ON SATELLITE ORBITS II, by Herbert Knothe and Richard H. Anderson. May 59, 16p. AFMDC-TR-59-19; AD-215 112.
Order from LC mi$2.40, ph$3.30 PB 142 376

The parameter p of the oscillating ellipse of the orbit is investigated, above all its behavior after a large number of rotations. It is particularly important to study the parameter p because the knowledge of its behavior determines not only the variations of the inclination i but also the distance of the apogee and perigee.

Army Signal [Research and Development] Lab., Fort Monmouth, N. J.
INVESTIGATION OF RELAY TERMINAL HEADER PERFORMANCE AT HIGH ALTITUDES UP TO 350,000 FEET, by Sol Bremmer. 6 Feb 57, 26p. 8 refs. Technical memo. M-1858; AD-143 878.
Order from LC mi$2.70, ph$4.80 PB 142 570

The investigation showed no essential differences between 2.5- and 2.9-cm-diam relay terminal headers. The terminal headers were of the solder sealed glass bushing type and were representative of the standard used in the manufacture of sealed military relays. Distances across the glass bushing were slightly less than 2 mm in all instances. The hooked pins and the straight pins were alternately exposed to the high-altitude environment to determine the effect of pin configuration on the sparking potential. The alignment of the hooked terminal pins in parallel planes may increase the sparking potential under high-pressure conditions. The sparking potential was independent of the material content of the glass bushing since initial failure occurred through the surrounding medium. Tracking across the insulator is dependent upon the content of the air. A minimum sparking potential of approximately 300 v was observed at a pressure of approximatley 2000 μ; above and below this pressure, the sparking potential increased. At pressures less than 2000 μ, the glow phenomenon was observed; sparking potential values could not be duplicated exactly, but were fairly consistent. At pressures greater than approximately 2000 μ, an abrupt change of current was observed for a constant potential applied. Because of difficulties in measuring pressure, the data accumulated were considered unreliable. However, sparking potentials never fell below 300 v.

Bolt, Beranek and Newman, Inc. [Cambridge, Mass.]
PRELIMINARY SURVEY OF HIGH-SPEED IMPACT INFORMATION, by Peter A. Franken. Rept. for Apr-Sep 58 on Materials Analysis and Evaluation Techniques, Contract AF 33(616)5730. June 59, 30p. 17 refs. WADC Technical rept. 58-577; AD-216 029.
Order from OTS $0.75 PB 151 947

This report summarized studies of high-speed impact now under way. Experimental facilities for obtaining high velocities are considered, and advantages and disadvantages associated with the various propulsion systems are discussed. A separate classified table lists capabilities of existing propulsion systems. Methods of analyzing high-speed impact data are reviewed.

Bureau of Ordnance, Dept. of the Navy, Washington, D. C.
PREPARATION OF DRAWINGS AND LISTS OF DRAWINGS. 18 Feb 57, 126p. NAVORD OSTD 599 (First rev.).
Order from LC mi$6.30, ph$19.80 PB 142 496

This standard establishes the minimum requirements for the preparation and revision of Bureau of Ordnance drawings applicable to weapons and associated equipment procured for service evaluation or service use. Drawings for experimental and developmental models need not conform to this standard unless specifically directed.

Diamond Ordnance Fuze Labs., Washington, D. C.
A TRANSISTORIZED 20-MM TEMPERATURE TELEMETER, by Robert W. Yancey. 24 Apr 59, 11p. TR-671.
Order from LC mi$2.40, ph$3.30 PB 142 851

A unit has been developed for monitoring and telemetering the skin temperatures of 20-mm and 40-mm projectiles in free flight. This unit consists of a VHF transistor oscillator incorporating a ferrite-core tank-circuit coil, and a thermocouple that varies the current through another winding on the ferrite core in response to the nose temperature. This varies the permeability of the core, and, consequently the operating frequency of the oscillator. The maximum telemetering range of this unit is 50 to 60 ft.

Institute of Metals and Explosives Research, U. of Utah, Salt Lake City.
MECHANISM OF CRATERING IN ULTRA-HIGH VELOCITY IMPACT, by Melvin A. Cook. Rept. on Contract AF 18(603)100. 30 Jan 59, 28p. 19 refs.
Order from LC mi$2.70, ph$4.80 PB 142 679

The equations of the hydrodynamic theory of penetration of targets by shaped charge jets are presented. A theory is presented that takes into account heat losses by compression, shock heating and radiated shock waves. The conditions for impact explosions of targets are extended to cover the entire velocity range of impact from the plastic deformation threshold $v_o$ to well above the impact explosion threshold $v_c$.

Institute of Molecular Physics, U. of Maryland, College Park.
A COMPARISON STUDY BETWEEN A MICROWAVE INTERFEROMETER AND AN ELECTRICAL CONTACT SYSTEM FOR FOLLOWING THE MOTION OF A HIGH SPEED PROJECTILE, by Z. I. Slawsky, A. E. Seigel and others. Rept. on Contract Nonr-595(02). 20 Aug 58, 22p. 12 refs.
Order from LC mi$2.70, ph$4.80 PB 142 459

A comparison study has been made between two different methods of tracking a high speed missile in a barrel. This comparison between a microwave interferometer and an electrical contact system indicates that there are no systematic errors in either system in the velocity range from 250 m/sec to 425 m/sec. It is pointed out, however, that the microwave system must be used if reliable isentropic pressure vs. density curves are to be obtained for the expanding gas behind the missile.

Michigan U., Ann Arbor.
DETONATION OF HYDROGEN-OXYGEN MIXTURES AT HIGH INITIAL PRESSURE, by Roy L. Gealer and Stuart W. Churchill. Rept. on Contract Nonr-1858(25). Sep 58, 31p. 15 refs. Proj. Squid Technical rept. MICH-5-P.
Order from LC mi$3.00, ph$6.30 PB 142 397

Detonation velocities in $H_2$-$O_2$ mixtures were measured in a half-inch-diameter tube at room temperature for initial compositions from 0.40 to 0.80 mole fraction $H_2$ and initial pressures from 14.4 to 1000 psia. An experimental increase in detonation velocity of 11.4 to 15.6% (depending on the initial composition) was observed over this pressure range.

Naval Proving Ground, Dahlgren, Va.
EQUATIONS OF MOTION FOR TWO RIGID BODIES COUPLED BY A BEARING, by C. H. Frick. 25 Nov 58, 37p. 3 refs. NPG rept. no. 1630.
Order from LC mi$3.00, ph$6.30 PB 139 417

Differential equations are developed for the motion of a spinning rocket coupled to a second body by a bearing. Two cases are considered. For the more restricted case, the second body, the one which does not contain the rocket fuel, is assumed to have rotational symmetry about the bearing axis. In the more general case, the only restriction on the mass distribution is that the second body should have mirror symmetry about a plane passing through the bearing axis, while the propellant center of mass and moments of inertia may have general time histories relative to axes fixed with respect to the rocket walls. For the two cases prepared for computation on the Naval Ordnance Research Calculator (NORC) and used in studies of the Vanguard third stage, a zero air density and an inverse-square gravitational force were assumed.

Purdue U. School of Aeronautical Engineering, Lafayette, Ind.
MATHEMATICAL THEORY OF THE OPTIMUM TRAJECTORIES OF A ROCKET, by Angelo Miele. Final rept. on Contract AF 18(603)69. Nov 58, 36p. 22 refs. Rept. no. A-58-10; AFOSR TR-58-154; AD-206 361.
Order from LC mi$3.00, ph$6.30 PB 139 230

Under the sponsorship of the Office of Scientific Research of the United States Air Force, an investigation of a wide class of variational problems of interest in rocket flight has been developed. The scientific results obtained reviewed, with particular regard to the following topics: Optimum thrust programming for level flight, optimum thrust programming for vertical flight, optimum thrust programming for arbitrarily inclined rectilinear trajectories, non-lifting trajectories, gliding paths, interception paths, vacuum flight trajectories, LEGENDRE-CLEBSCH, WEIERSTRASS, and JACOBI-MAYER conditions, variational problems with consideration of the variable gravitational field and rotation of the Earth.

# FOOD, HANDLING, AND PACKAGING EQUIPMENT

## Food

DK Mfg. Co., Inc., Chicago, Ill.
DESIGN AND DEVELOPMENT OF A ONE QUART INSULATED RECTANGULAR BEVERAGE CONTAINER, by L. Miller. Rept. for 15 Mar 56-14 Oct 57 on Theoretical Capabilities and Technical Feasibility of All Practical Insulating Materials and Techniques in Relation to the Fabrication of a Container, Contract AF 33(616)3574. Dec 58, 25p. WADC Technical rept. 57-635; AD-142 085
Order from OTS $0.75. PB 151 700

Forest Products Lab. [Madison, Wis.]
PRESSURE-SENSITIVE TAPE SUSPENSION SYSTEMS FOR AIRCRAFT PARTS IN SHIPPING CONTAINERS. PART I. LABORATORY TESTS OF SUSPENSION SYSTEMS, by Arnold W. Voss. Rept. for Feb 57-June 58 on Finishes and Materials Preservation, Contract [AF] 33(600)53-4023. June 59, 70p. 10 refs. WADC Technical rept. 58-455, Pt. 1; AD-216 533.
Order from OTS $1.75 PB 151 945

A suspension system utilizing pressure-sensitive tape in lieu of blocking and bracing or other means of supporting aircraft parts in a shipping container was found adequate to pass the rough-handling tests prescribed for military packaging. Methods of attaching the tapes to the container and necessary precautions were determined. The relationship between the weight of the item and the strength required for glass filament-reinforced tape was determined and a basis established for the design of tape suspension systems.

Walter Reed Army Inst. of Research, Washington, D. C.
AN EVALUATION OF METHODS FOR DETECTING FOREIGN FATS IN DAIRY PRODUCTS, by Flo. H. Ward, E. S. Windham, and C. W. Hiatt. Final rept. on Metabolism and Nutrition. Dec 55, 13p. 16 refs. WRAIR-93-55; AD-109 578.
Order from LC mi$2.40, ph$3.30 PB 139 390

Several methods of detecting foreign fat in milk fat were evaluated as a preliminary to a more intensive evaluation by the Association of Official Agricultural Chemists. Of the six methods used for the rapid isolation of fat, the methods of Sager and Sanders along with those of Martin, Rutz, and Whitnah were found to be the most effective. The method which employs the "critical temperature of dissolution" (Felman and Lepper) was found to be superior to the Seidenberg

Turbidity Method or the Keeney Crystallization Test as a means of rapidly screening samples. The Keeney method for determining the butyric acid content in a dairy product was found to be less difficult than a similar method proposed by Harper and Armstrong. Methods based on the determination of a sample's tocopherol content (as proposed by Bird, Mahon, and Chapman respectively) for detecting adulteration were found to be effective. The Mahon and Chapman technic were the easiest to perform.

## MACHINERY, FABRICATION, AND ACCESSORY EQUIPMENT

### Engines and Propulsion Systems

Air Force Missile Development Center, Holloman AFB, N. Mex.
RELATIVISTIC TREATMENT OF AN OPTIMUM ROCKET PROPULSION SYSTEM UNDER CONSIDERATION OF NUCLEAR DATA, by Trutz Foelsche and Herbert Knothe. Apr 59, 14p. 2 refs. AFMDC-TN-59-8; AD-214 006.
Order from LC mi$2.40, ph$3.30 PB 142 377

It is shown that for nuclear physical reasons an end velocity higher than 0.134c cannot be attained by a rocket using a propulsion system with variable exhaust velocity, which maximizes the end velocity at given energy content and mass ratio.

Arnold Engineering Development Center [Tullahoma, Tenn.]
PERFORMANCE OF A SCALE MODEL FREE-JET ENGINE TEST INSTALLATION INCORPORATING DIFFUSERS WITH SQUARE OUTER FAIRINGS, by E. K. Latvala. Rept. on ARO, Inc., Contract AF 40(600)700. Feb 59, 44p. 3 refs. AEDC-TN-58-100; AD-210 212.
Order from LC mi$3.30, ph$7.80 PB 139 466

The results of an investigation of a series of free-jet shroud diffusers having square outer fairings and conical inner fairings are presented. The tests were conducted in a model installation with a 35-percent blockage inlet at Mach numbers of 2.50, 2.80, and 3.10. Comparison is made with data obtained from other tests in which an annular diffuser configuration was used.

Avco Research Lab. [Everett, Mass].
A DESCRIPTION OF A PROPULSIVE DEVICE WHICH EMPLOYS A MAGNETIC FIELD AS A DRIVING FORCE, by R. M. Patrick. Rept. on Contract AF 49(638)61. May 58, 11p. 5 refs. Research rept. no. 28; AD-159 614.
Order from LC mi$2.40, ph$3.30 PB 142 399

A propulsion motor for space ships is described which produces thrust by using a magnetic field to expell a plasma. It is pointed out that the main difference between this magnetic accelerator and the ion rocket is that the magnetic device produces an electrically neutral plasma as the accelerated mass, while the ion rocket accelerates a charged mass. Experiments have been carried out at the AVCO Research Laboratory using a model of this device. The results of these experiments as well as application of these results to an actual propulsion motor are discussed. A comparison between this magnetic accelerator and other means of acceleration, in particular ion rockets is made. Furthermore, it is pointed out that the mass of the capacitors which furnish the accelerating current for the magnetic device accounts for the major portion of its total mass.

Feltman Research and Engineering Labs., Picatinny Arsenal, Dover, N. J.
ABRIDGED SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF AVAILABLE STABILIZER AND APPLICATION TO PREDICTION OF SAFE LIFE OF PROPELLANTS, by Milton Roth, Mario A. Laccetti, and M. R. Younginer. June 59, 17p. 16 refs. Technical memo. no. GL-8-59.
Order from LC mi$2.40, ph$3.30 PB 142 740

An abridged spectrophotometric method has been developed for the determination of available stabilizer content of propellants containing diphenylamine or ethyl centralite. This is accomplished by steam distillation from alkaline solution and subsequent absorbance measurement at a wavelength suitable for the particular stabilizer. Total assaying time is less than one hour. The method has been applied to artificially aged propellants and indicates a regular decrease of stabilizer content with time. An empirical mathematical relationship has been derived for the rate of decay of stabilizer and the equation has been applied to predicting available stabilizer content at any given time.

Picatinny Arsenal, Dover, N. J.
PRODUCTION ENGINEERING OF M8 (X209B2) JATO by Benjamin Kroll. Apr 59, 22p. 2 refs. Technical rept. DC-TR:17-58.
Order from LC mi$2.70, ph$4.80 PB 142 045

Program to-date is covered as well as some of the achievements.

Reed Research, Inc., Washington, D. C.
MARINE PROPULSION. VOLUME I. A HISTORY OF PROPULSION DEVELOPMENT, by Robert Taggart. Rept. on Contract DA 44-177-tc-409. 15 July 57, 173p. 76 refs. AD-148 483.
Order from LC mi$8.10, ph$27.30 PB 142 436

Contents:
The early years
The heyday of the paddle-wheel, 1800-1860
The development of the screw propeller, 1800-1860
Novel forms of propulsion, 1800-1900
Improvement of the screw propeller, 1860-1950
Special purpose propulsion systems, 1900-1950
Unconventional propulsion devices, 1900-1950
Recent developments in ship propulsion

Stanford Research Inst. [Menlo Park, Calif.]
INVESTIGATION OF JET FLAMEHOLDERS, by G. A. Agoston, R. H. Eustis and others. Rept. for 1 Mar-31 Aug 57 on Contract AF 33(616)3970. Sep 58, 46p. 17 refs. WADC Technical note 56-316, Pt. 3; AD-211 846.
Order from OTS $1.25 PB 151 911

Experiments and analyses were performed to contribute to a basic understanding of the holding of flame in a stream of a combustible gas mixture by a small gas jet directed upstream. A pilot flame was delineated, and its significant time-averaged dimensions were noted as a function of jet and main-stream velocities. New evidence was obtained indicating the occurrence of recirculation. The influence of nonuniform fuel concentration patterns in the main stream on flame stability limits was investigated. Interpretation of the data leads to conclusions which conflict with a currently held mechanism for reversed-jet flame stabilization. A mechanism is proposed which is plausible in the light of current observations. An analytical comparison was made of the relative performance of jet and conventional flameholders in the afterburner of a turbojet aircraft. A representative set of flight and basic engine performance characteristics was assumed, together with a range of afterburner operating parameters. For some combinations of parameters, the fuel consumption of the conventional afterburner exceeded that of the jet type over three percent. (See also PB 131 269)

## Machine Parts and Mechanisms

Columbia U., New York.
GAS-LUBRICATED BEARINGS, A CRITICAL SURVEY, by Gilbert F. Boeker, Dudley D. Fuller, and Carl F. Kayan. Rept. on Contract AF 33(616)5054. July 58, 298p. 66 refs. WADC Technical rept. 58-495; AD-216 356.
Order from OTS $4.00 PB 151 946

Part I of this report summarizes the work on the hydrodynamic types of gas-lubricated thrust and journal bearings with their attendant problems such as self-excited shaft vibrations. In Part II, the literature on externally-pressurized bearings is critically reviewed. An effort has been made to present a broad picture of what is known in terms of analysis, design and performance for these bearings. Emphasis has been given to those areas where further information is definitely needed. Part III describes an electrical network useful in analyzing the pressure and flow relations within the various portions of the gas-bearing path.

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
THE INFLUENCE OF THE MOLECULAR MEAN FREE PATH ON THE PERFORMANCE OF HYDRODYNAMIC GAS LUBRICATED BEARINGS, by Albert Burgdorfer. Rept. on Contract Nonr-2342(00). June 58, 22p. 7 refs. Interim rept. I-A2049-2.
Order from LC mi$2.70, ph$4.80 PB 142 552

This report describes one item of investigation from the general research program being conducted at The Franklin Institute Laboratories on the fundamental aspects of gas lubricated bearings.

Franklin Inst. Lab. for Research and Development, Philadelphia, Pa.
RESEARCH ON GAS LUBRICATED BEARINGS, by Dudley D. Fuller. Annual rept. no. 1, 1 Apr 57 - 1 Apr 58, on Contract Nonr-2342(00). 15 July 58, 27p. Interim rept. I-A2049-3.
Order from LC mi$2.70, ph$4.80 PB 142 544

This is a summary report on the activities of the research program conducted for the Office of Naval Research under Contract Nonr-2342(00), "Research on Gas Lubricated Bearings", for the first year of effort, April 1, 1957 to April 1, 1958. The purpose of this investigation is to conduct a broad and basic program of analytical and experimental research into the fundamental behavior of gas-lubricated bearings and to establish general design criteria for these bearings.

## Manufacturing Equipment and Processes

Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF TECHNIQUES FOR SUBMERGED-ARC WELDING BUTT JOINTS IN THICK PLATES OF HY-80 STEEL, by J. A. Kincks, W. J. Lewis and others. Summary rept. for 1 May 56-1 July 57 on Contract NObs-72119. 30 June 57, 49p. 1 ref. AD-144 870.
Order from LC mi$3.30, ph$7.80 PB 139 201

The weld-metal notch toughness of submerged-arc welds with the commercial wire was much lower at room temperatures than that of inert-gas-shielded metal-arc welds with the same wire. The notch toughness of the welds was about the same below -40°F.

Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio.
THE FABRICATION OF TUNGSTEN, by V. D. Barth. Rept. on Contract AF 18(600)1375. 14 Aug 59, 65p. 63 refs. DMIC rept. 115.
Order from OTS $1.75 PB 151 071

The outstanding strength of tungsten is illustrated by a comparison of some of its significant physical properties with those of other metals. The effects produced by heating tungsten are discussed. The most important of these changes is the ductile-brittle transition at about 200 to 400 C, and the effective recrystallization temperature at about 1500 C or above. The consolidation of tungsten by powder-metallurgy procedures and by arc melting is summarized. Considerations of importance in primary working, secondary working, and joining are also summarized.

## Transport, Traction and Hoist Facilities

Columbia U., New York.
RAILROADS OF MADAGASCAR, by William A. Hance. Rept. on Contract Nonr-266(29). [1958] 12p. 11 refs.
Order from LC mi$2.40, ph$3.30 PB 142 575

There are two meter-gauge rail lines on Madagascar with a total length of only 528 miles. Although limited in extent, the rail lines do serve four of the eight leading cities of the island. They are well equipped, well run and, in recent years, have operated at a slight profit. They provide a welcome contrast to the inadequate and difficult roads and ports of Madagascar.

David Taylor Model Basin, Washington; D. C.
THE PITCHING PERFORMANCE OF THE SS SILVER MARINER IN A STATE 5 SEA, by Wilbur Marks. May 59, 22p. 13 refs. Rept. 1293.
Order from LC mi$2.70, ph$4.80 PB 142 477

Continuous time histories of pitch experienced by the SS SILVER MARINER in a State 5 sea were recorded. The measurements, each at least 28 minutes long, were taken at various ship speeds in head seas, and at various relative headings for the top operating speed. The resultant information was transformed into energy spectra, and a number of statistics that describe the ship's pitching performance were computed. It is shown that variation of heading is more influential in pitching behavior than is variation of ship speed. For this ship, bow seas (rather than head seas) and moderately high speeds (18 knots) at this heading are shown to produce maximum pitching. Prediction of maximum pitch angle from the computed spectra agrees well with observed maximum pitch angle.

# MATERIALS

## Fuels, Lubricants, and Hydraulic Fluids

Material Lab., New York Naval Shipyard, Brooklyn.
RESEARCH AND DEVELOPMENT OF THE COPPER CONTAMINATION OF JP-5 JET FUEL BY 90-10 AND 70-30 COPPER-NICKEL ALLOYS, by J. M. Perel. Final rept. 21 Nov 57, 45p. 14 refs. Lab. Project 5319-29; AD-156 659.
Order from LC mi$3.30, ph$7.80 PB 139 188

Single and two phase immersions, using JP-5 fuel and sea water, were conducted to evaluate the factors affecting the rate and extent of copper contamination of the fuel by 70-30 and 90-10 copper-nickel alloys. The 70-30 alloy exhibited the greater resistance to corrosion by fuel and/or sea water. Free naphthenic acid produced the greatest contamination of the fuel, and nullified the inhibiting effect of Santolone "C" in two phase systems. Copper was assayed spectrophotometrically with Neocuproine as color reagent.

Materials Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
THE QUANTITATIVE ANALYSIS OF 5, ETHYL-10, 10-DIPHENYLPHENAZASILINE IN AROMATIC BASE STOCK FLUID PRIOR TO PERFORMANCE TESTING, by James T. Thompson. Rept. for July-Dec 58 on Materials Analysis and Evaluation Techniques. May 59, 14p. 3 refs. WADC Technical note 58-368; AD-214 696.
Order from OTS $0.50 PB 151 913

A quantitative ultra-violet method, based on Beer's Law, has been developed for determining the quantity of an antioxidant additive (5-ethyl-10, 10-diphenylphenazasiline) when blended with an aromatic base stock fluid. The method is applicable prior to performance testing for lubricity.

Pennsylvania State U., University Park.
INDUCED AIR FLOWS IN FUEL SPRAYS, by Hikmet Binark and W. E. Ranz. Rept. on Contract Nonr-1858(25). Apr 58, 27p. 1 ref. Proj. Squid Technical rept. PSU-1-P.
Order from LC mi$2.70, ph$4.80 PB 142 554

A series of experiments are reported which demonstrate qualitative and quantitative aspects of induced air flow in and near the penetration zones of hollow and solid cone sprays.

Pennsylvania State U., University Park.
SOME OBSERVATIONS ON AIR FLOW PATTERNS AROUND AND IN A CONFINED HOLLOW CONE SPRAY, by Hikmet Binark and W. E. Ranz. Final rept., Phase 2, on Project Squid, Contract Nonr-1858(25). Sep 58, 24p. 2 refs. Technical rept. PSU-3-R.
Order from LC mi$2.70, ph$4.80 PB 142 458

Some observations on air flow patterns around and in a confined hollow cone spray are described. Flow patterns in a combustor model were observed for primary and secondary forced flows.

Virginia U., Charlottesville.
HIGH TEMPERATURE ANTIOXIDANTS FOR SYNTHETIC FLUIDS, by James W. Cole, Jr. Rept. on Contract AF 18(603)103. Jan 59, 13p. 15 refs. AFOSR-TN-59-149; AD-210 983.
Order from LC mi$2.40, ph$3.30 PB 142 507

Studies were made (1) to evaluate antioxidants for possible use at 400°F and above in synthetic fluids, (2) to synthesize likely antioxidants related to phenothiazine (thiodiphenylamine) and other promising types, and (3) to study modes and mechanisms of antioxidant action at elevated temperatures. Over 400 different compounds, representing a broad spectrum of additives, were examined in selected combinations with about 20 synthetic fluids. The types of fluid included ester fluids, silicates, silicones, silanes, phosphates, and mineral oil. About 50 derivatives of phenothiazine were synthesized and characterized, most of which were evaluated as antioxidants. The ring-substituted derivatives of phenothiazine showed varying degrees of antioxidant activity. The oxidation behavior of blended fluids was examined in the presence of metals such as Cu, Ag, Mg, and alloys of Fe, and Ti. Some metals, like Cu,

to help generate antioxidant species, especially with amines. Atoms of N, S, and Se are important elements in antioxidants when located in strategic positions in the molecule. (Presented to a Symposium of Functional Fluids and Synthetic Lubricants, American Chemical Society Meeting, Chicago, Ill., Sept. 8, 1958).

## Paints and Finishes

Rock Island Arsenal Lab., Ill.
PHOSPHATE COATING STUDIES USING X-RAY DIFFRACTION, by James W. McGarvey and Paul G. Chamberlain, 11 Apr 57, 13p. 5 refs. Rept. no. 57-937.
Order from LC mi$2.40, ph$3.30 PB 142 694

X-ray diffraction techniques were used to analyze zinc phosphate coatings formed on steel in hot, room temperature, and "phospaste" zinc phosphating processes. The optical microscope was also used to demonstrate the similarities existing among the coatings from the three phosphating processes.

Rock Island Arsenal Lab., Ill.
ZINC AND IRON ANALYSIS OF ZINC PHOSPHATE COATINGS USING THE EMISSION SPECTROGRAPH, by Paul G. Chamberlain and James W. McGarvey. 10 Apr 57, 13p. 4 refs. Rept. no. 57-931.
Order from LC mi$2.40, ph$3.30 PB 142 693

The emission spectrographic technique developed in this study is a method for the quantitative analysis for both zinc and iron in zinc phosphate coatings. This method may be extended to include the determination of phosphorus and to other types of phosphate coatings.

## Photographic Materials

Air Force Missile Development Center, Holloman AFB, N. Mex.
REDUCTION OF BALLISTIC CAMERA PLATES, by Charles A. Bodwell and Paul D. Jose. Rept. on Project Space Track. Jan 59, 68p. AFMDC-TR-59-5; AD-154 107.
Order from LC mi$3.90, ph$10.80 PB 142 378

This report discusses the bias errors and makes provision for removing them from the data before applying the least-squares technique for minimizing the random errors. The annex outlines the necessary sequence of computation and gives a complete example of the numerical work required for a particular plate.

## Wood and Paper

College of Forestry, Syracuse U., N. Y.
THE MECHANISM OF SOLUTION OF HEMICELLULOSE IN ALKALI, by Conrad Schuerch. Final technical rept. for 1 Feb 54-1 June 59 on Contracts DA 30-115-ORD-(514, 712, 923) 10 June 59, 7p. 9 refs.
Order from LC mi$1.80, ph$1.80 PB 142 747

Brief comments on coverage and publications to date.

Naval Research Lab., Washington, D. C.
MARINE BORER CONTROL. PART IX. A TOXICITY SCREENING TEST FOR CANDIDATE MARINE WOOD PRESERVATIVES, by T. R. Sweeney and C. E. Patouillet. Interim rept. 4 Aug 59, 8p. 12 refs. NRL rept. 5363.
Order from OTS $0.50 PB 151 807

A toxicity test, using as the test organism the brine shrimp, Artemia salina, was developed as a means of screening candidate marine wood preservatives. Toxicities of a number of creosote fractions and modifications were determined. The toxicities of these fractions to Artemia increased with increased boiling point, as did their resistance to Teredinidae attack in previous exposure tests. With the exception of "synthetic" creosote, all the fractions tested that had a minimum lethal concentration of 10 ppm or less stood up well in the exposure tests, both before and after leaching. Good correlation was observed between the toxicity of these materials to Artemia and their ability to impart to wood a resistance to marine borer attack. (See also PB 139 730)

## MATHEMATICS

Air Force Cambridge Research Center, Bedford, Mass.
TABLE OF S(X) AND ITS FIRST ELEVEN DERIVATIVES. VOLUME 2. VALUES 6,000 TO 11,999, by Werner W. Gerbes, George E. Reynolds and others. Feb 58, 243p. AFCRC TR-58-117(II); AD-146 838.
Order from LC mi$11.10, ph$37.80 PB 139 332

Antenna design is somewhat simplified by introducing a special function S(x). Problems are more conveniently solved in terms of this new function and its derivatives. The new function, which resembles the sine integral in some respects, is

$$\int_0^x \left(\frac{\sin u/2}{u/2}\right)^2 du.$$

A table of 216,000 values of X(x) and its first 11 derivatives has been compiled to six-place accuracy for every circular degree over 50 cycles, that is, $x = 0^{o}(1^{o})18,000$; 6D.

Air Force Cambridge Research Center, Bedford, Mass.
TABLE OF S(X) AND ITS FIRST ELEVEN DERIVATIVES. VOLUME 3. VALUES 12,000 TO 18,000, by Werner W. Gerbes, George E. Reynolds and others. Feb 58, 243p. AFCRC TR-58-117(III); AD-146 839.
Order from LC mi$11.10, ph$37.80 PB 139 333

See also PB 139 332.

Air Force Cambridge Research Center, Bedford, Mass.
THE ZEROS AND MAXIMA OF THE AIRY FUNCTION AND ITS FIRST DERIVATIVE TO 25 SIGNIFICANT FIGURES, by Murray E. Sherry. Apr 59, 13p. 4 refs. AFCRC-TR-59-135; AD-214 568.
Order from LC mi$2.40, ph$3.30 PB 142 835

American Mathematical Society, Providence, R. I.
SEMINAR IN APPLIED MATHEMATICS HELD AT BOULDER, COLORADO, ON JUNE 23, 1957-JULY 19, 1957. FINAL DESCRIPTIVE REPORT, by J. H. Curtiss. 20 Dec 57, 74p. AFOSR TR-58-2; AD-148 036.
Order from LC mi$4.50, ph$12.30 PB 142 853

Applied Mathematics and Statistics Lab., Stanford U., Calif.
ALMOST PERIODIC COMPACTIFICATIONS, by Karel Deleeuw and Irving Glicksberg. Technical note no. 1 on Contract AF 49(638)294. 16 Dec 58, 13p. 13 refs. AFOSR TN-58-934; AD-205 092.
Order from LC mi$2.40, ph$3.30 PB 139 405

Applied Mathematics and Statistics Lab., Stanford U., Calif.
FREDHOIM EIGEN VALUES OF MULTIPLY-CONNECTED DOMAINS, by M. Schiffer. Technical rept. no. 77 on Contract Nonr-225(11). 4 Sep 58, 111p. 23 refs. AD-202 774.
Order from LC mi$6.00, ph$12.30 PB 142 602

In a preceding paper, these Fredholm eigen functions were applied to problems of conformal mapping of simply-connected plane domains. In the present paper, the Fredholm eigen value problem is studied in the case of multiply-connected plane domains. Various new difficulties arise in this case. The complementary region of a multiply-connected domain is a domain set and the number of trivial solutions of the problem with the eigen values $|\lambda| = 1$ increases. This fact necessitates a brief restatement of the basic definitions and concepts in Section 1. In Section 2, the dielectric Green's functions $g_\epsilon(z, \zeta)$ of a multiply-connected domain are discussed and their Fourier development in terms of the Fredholm eigen functions is given. In Section 4 it is proved that not only the limit cases $\epsilon \to 0$ and $\epsilon \to \infty$ of $g_\epsilon(z, \zeta)$ give rise to univalent functions in the domain but that each dielectric Green's function does so.

California U., Berkeley.
VIBRATION OF A NONHOMOGENEOUS MEMBRANE, by M. H. Protter. Technical rept. no. 5 on Contract AF 49(638)398. Apr 59, 13p. 1 ref. AFOSR-TN-59-279; AD-212 912.
Order from LC mi$2.40, ph$3.30 PB 142 829

Nehari obtained an inequality between the first eigenvalue of a nonhomogeneous vibrating membrane fixed on the boundary, and that of a homogeneous circular membrane of the same mass. In this paper the first eigenvalue of nonhomogeneous and homogeneous membranes of the same shape are compared. Further, the eigenvalues of two different nonhomogeneous membranes of the same shape are compared.

California U., Los Angeles.
A REMARK TO SARIO'S LEMMA ON HARMONIC FUNCTIONS, by Kotaro Oikawa. Technical rept. no. 10 on Contract DA 04-495-ORD-722. Feb 59, 8p. 2 refs. AD-211 354.
Order from LC mi$1.80, ph$1.80 PB 142 479

The smallest possible value is evaluated for the constant q of Sario's lemma on harmonic functions. Sairo's lemma: Let W be an open Riemann surface and K be a compact set on W. Then there exists a constant q such that $0 < q < 1$ and that $\max_K |u| \leq q \sup_W |u|$ for every harmonic function u which changes sign on K.

Chicago U., Ill.
FINITE GROUPS WITH FIXED-POINT-FREE AUTOMORPHISMS OF PRIME ORDER, by John Thompson. Technical note on Research on Algebraic Mechanism of Fiber Spaces, Contract AF 18(600)1383. Feb 59, 9p. 17 refs. AFOSR-TN-59-180; AD-211 320.
Order from LC mi$1.80, ph$1.80 PB 142 830

Chicago U., Ill.
THE $H_p$-PROBLEM AND THE STRUCTURE OF $H_p$-GROUPS, by D. R. Hughes and J. G. Thompson. Rept. on Research on Algebraic Mechanism of Fiber Spaces, Contract AF 18(600)1383. Jan 59, 12p. 6 refs. AFOSR-TN-59-26; AD-208 869.
Order from LC mi$2.40, ph$3.30 PB 142 831

Chicago U., Ill.
HOMOLOGICAL DIMENSION OF RINGS AND MODULES, by Irving Kaplansky. Technical rept. no. 1 on Investigations in Algebras and Finite Fields, Contract DA 11-022-ORD-2492. Mar 59. 48p. AD-213 100.
Order from LC mi$3.30, ph$7.80 PB 142 512

A reproduction is presented of the major part of a course given at the University of Chicago in the Fall of 1958. To reach the Auslander-Buchsbaum-Serre characterization of regular local rings by the shortest known route, a theory of homological dimension, which was easy to find and pursue, is used.

Hebrew U. (Israel).
ANALYTIC FUNCTIONS OF THE CLASSES $L^2$ AND $\ell^2$ AND THEIR KERNEL FUNCTIONS, by Michael Maschler. Technical note no. 1 on Contract

AF 61(052)187. Dec 58, 32p. 17 refs. AFOSR TN-59-342; AD-213 662.
Order from LC mi$3.00, ph$6.30 PB 142 481

Hebrew U. (Israel).
ON A THEOREM OF KIRSZBRAUN [and] ON A PROBLEM OF S. MAZUR, by B. Grunbaum. Technical notes nos. 3 and 4 on Contract AF 61(052)04. Jan 58, 15p. 7 refs. AFOSR TN-58-401; AD-158 203.
Order from LC mi$2.40, ph$3.30 PB 142 773

Hebrew U. (Israel).
ON DIVERGENCE OF RANDOM POWER SERIES, by A. Dvoretzky and P. Erdös. Technical (scientific) note no. 3 on Contract AF 61(052)187. Feb 59, 9p. 3 refs. AFOSR-TN-59-344; AD-213 664.
Order from LC mi$1.80, ph$1.80 PB 142 828

Hebrew U. (Israel).
ON THE ITERATION PRODUCT OF SUMMABILITY METHODS; NEW CLASSES OF TRANSFORMATIONS AND THEIR PROPERTIES, by Amnon Jakimovski. Technical note no. 2 (Scientific) on Contract AF 61(052)187. Feb 59, 56p. 14 refs. AFOSR TN-59-343; AD-213 663.
Order from LC mi$3.60, ph$9.30 PB 142 480

Two new classes of transformation, which might be looked upon respectively, as the sequence-to-function analogues to the Hausdorff and quasi-Hausdorff transformations are defined and investigated, and their relation to the iteration product problem is shown.

Institute for Advanced Study, Princeton, N. J.
FINAL REPORT OF RESEARCH ACCOMPLISHED DURING ACADEMIC YEAR 1958-1959, by Joseph J. Kohn. Rept. on Contract Nonr-1358(05). 10 Sep 58, 3p. 5 refs.
Order from LC mi$1.80, ph$1.80 PB 142 457

A very brief summary of work on the problem of regularization of singular integral operators on sections of a vector bundle over a compact manifold; the connections between potential-theoretic methods and the Cartan-Stein methods in the study of complex analytic manifolds; theoretical applications of the $\bar{\partial}$-Neumann problem; and a systematic account of potential theory on manifolds.

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
AUXILIARY INTEGRALS FOR LATTICE SUMS, by A. A. Maraudin and G. H. Weiss (Weizmann Inst. of Science). Rept. on Contract AF 18(600)1315. Dec 58, 13p. 5 refs. Technical note BN-156; AFOSR-TN-59-55; AD-209 426.
Order from LC mi$2.40, ph$3.30 PB 139 214

The integrals

$$C_m(x) = \int_0^\infty t^m e^{-xt}\, dt$$

are tabulated for the following values of x and m:

$x = 0.2(0.2)20$ and $m = 0.5(1)12.5$ .

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
EXACT BOUNDS FOR SOLUTIONS OF HYPERBOLIC EQUATIONS BY FINITE DIFFERENCE METHODS, by H. F. Weinberger. Rept. on Contract AF 49(638)228. Mar 59, 15p. 8 refs. Technical note BN-165; AFOSR TN-59-372; AD-213 858.
Order from LC mi$2.40, ph$3.30 PB 142 533

The mean square deviation of the finite difference approximation from the solution of the wave equation vanishing on the surface of an N-cube and satisfying given Cauchy data is bound in terms of the Cauchy data. The bound is proportional to the mesh parameter h.

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
EXACT INFORMATION BY FINITE DIFFERENCE APPROXIMATION, by H. F. Weinberger. Rept. on Contract AF 49(638)228. June 59, 14p. 22 refs. Technical note BN-173; AFOSR TN-59-644.
Order from LC mi$2.40, ph$3.30 PB 142 689

It is shown how exact bounds for the stresses and the torsional rigidity in the classical torsion problem can be obtained from the solution of a corresponding finite difference problem.

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
ON AN ASYMPTOTIC EXPANSION OCCURRING IN THE EVALUATION OF A LATTICE SUM, by G. H. Weiss (Weizmann Inst. of Science) and A. A. Maradudin. Rept. on Contract AF 18(600)1315. Apr 59, 5p. 4 refs. Technical note BN-167; AFOSR TN-59-529; AD-216 536.
Order from LC mi$1.80, ph$1.80 PB 142 485

A simple derivation of asymptotic expansion which occurs in the evaluation of certain lattice sums is presented.

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
ON THE GENERALIZED RADIATION PROBLEM OF WEINSTEIN, by J. L. Lions. Rept. on Contract AF 49(638)228. Nov 58, 30p. 10 refs. Technical note BN-149; AFOSR TN-58-1039; AD-206 575.
Order from LC mi$2.70, ph$4.80 PB 142 567

A new solution of the generalized radiation problem; its uniqueness and non-existence for Re $k \geqslant 1$.

Institute for Fluid Dynamics and Applied Mathematics, U. of Maryland, College Park.
UNIQUENESS THEOREMS FOR THE DIFFERENTIAL EQUATION $u_{xy} = f(x, y, u, u_x, u_y)$ by Wolfgang Walter. Rept. on Contract AF 49(638)228. Feb 59, 28p. 10 refs. Technical note BN-159; AFOSR TN-59-577; AD-217 024.
Order from LC mi$2.70, ph$4.80 PB 142 680

A number of well known uniqueness theorems for the ordinary differential equation $y' = f(x, y)$- among them

the theorems of Nagumo and Osgood - are shown to be valid for the hyperbolic equation mentioned above.

Institute of Mathematical Sciences, New York U., N. Y.
ALIAS-FREE SAMPLING OF RANDOM NOISE, by Harold S. Shapiro and Richard A. Silverman. Rept. on Contracts AF 19(604)5238 and N6ori-20101. June 59, 42p. 10 refs. Research rept. EM-134; AFCRC TN-59-353; AD-216 368.
Order from LC mi$3.30, ph$7.80 PB 142 470

The question is studied of when the power spectrum of a stationary random process is uniquely determined by the values of the process measured in various ways at discrete instants of time. In the case of equi-spaced sampling, the power spectrum is not uniquely determined by the sampled data, i.e., aliasing is present. After a review of the equi-spaced case, the case is examined where the time markers are not equi-spaced, but are subject to jitter, and aliasing is found to persist. Next, the case is considered where the time markers are generated by an additive scheme, whereby each sampling time is derived from the previous one by the addition of an independent random variable, with characteristic function $\phi$ (s). Results show that additive random sampling is alias-free if $\phi$ (s) is one-to-one on the real axis, but not alias-free if $\phi$ (s) takes the same value at 2 distinct points of the open upper half-plane. Various alias-free sampling methods are exhibited, notably Poisson sampling.

Institute of Mathematical Sciences, New York U., N. Y.
ITERATION SCHEMES FOR SOLVING RECTANGULAR GAMES, by Harold N. Shapiro. Rept. on Contract Nonr-285(32). Dec 57, 12p. 2 refs. IMM-NYU 244.
Order from LC mi$2.40, ph$3.30 PB 139 393

Institute of Statistics, U. of North Carolina, Chapel Hill.
MINIMUM BIAS ESTIMATION, by William Jackson Hall. Rept. on Contract AF 49(638)261. Dec 58, 23p. 21 refs. Mimeograph series no. 213; AFOSR TN-59-215; AD-211 777.
Order from LC mi$2.70, ph$4.80 PB 142 677

This is an expository paper on the theory and application of minimum bias estimation, an approach to estimation theory which characterizes an estimator primarily according to its bias. Minimum risk theory, as developed by Wald and others, leads to estimators which minimize the average risk or the maximum risk. The place of bias in the risk theory is reinterpreted, and an alternative theory is developed with the role of the risk function replaced by a bias function (e.g., absolute bias, squared bias, or percentage absolute bias).

Institute of Statistics, U. of North Carolina, Chapel Hill.
A NOTE ON TESTING VARIOUS KINDS OF ASSOCIATION UNDER A MULTIVARIATE NORMAL LINEAR MODEL, by S. N. Roy. Rept. on Contract AF 49(638)213. Mar 59, 5p. 6 refs. Mimeograph Series no. 221; AFOSR TN-59-384; AD-214 191.
Order from LC mi$1.80, ph$1.80 PB 142 724

Institute of Statistics, North Carolina State Coll., Raleigh.
ON CERTAIN TYPES OF BIAS IN CURRENT METHODS OF RESPONSE SURFACE ESTIMATION, by H. R. van der Vaart. Technical rept. no. 22 on Experimental Designs for Industrial Research, Contract DA 36-039-ORD-1517. July 58, 19p. 13 refs. AD-200 573.
Order from LC mi$2.40, ph$3.30 PB 142 478

An investigation is made of current methods of estimating the quadratic surface $\eta = \eta_0 + \beta' \xi + \xi' \gamma \xi$, relative to maxima, minima, saddle points or stationary or rising ridges. For this problem $\eta_0$, $\beta$, and $\gamma$ are unknown; only their expectation-unbiased estimates are available. The discussion is carried out in terms of the distribution of the latent roots of symmetric, random matrices.

Institute of Statistics, U. of North Carolina, Chapel Hill.
ON THE CONSTRUCTION OF SETS OF PAIRWISE ORTHOGONAL LATIN SQUARES AND THE FALSITY OF A CONJECTURE OF EULER, by R. C. Bose and S. S. Shrikhande. Rept. on Contract AF 49(638)213. Apr 59, 32p. 21 refs. Mimeograph Series no. 222; AFOSR TN-59-401; AD-214 521.
Order from LC mi$3.00, ph$6.30 PB 142 723

Institute of Tech., U. of Minnesota, Minneapolis.
ONE AND TWO POINT BOUNDARY VALUE PROBLEMS FOR ORDINARY LINEAR DIFFERENTIAL EQUATIONS CONTAINING A PARAMETER, by George G. Chapin, Jr. Technical rept. no. 4, 15 Dec 58-15 Mar 59, on Problems in the Theory of Ordinary Differential and Difference Equations, Contract DA 11-022-ORD-2042. 10 Mar 59, 210p. 32 refs. AD-212 002.
Order from LC mi$9.30, ph$31.80 PB 142 542

Iowa State [U. of Science and Tech.] Ames.
TESTING EQUALITY OF MEANS WHEN VARIANCES MAY DIFFER, by John Gurland and Lloyd Rosenberg. Rept. on Contract AF 49(638)43. [1959] 38p. 10 refs. AFOSR-TN-58-1009; AD-206 152.
Order from LC mi$3.00, ph$6.30 PB 142 599

A finite series representation of the distribution of statistics with a structure similar to that of the t statistic has been utilized in obtaining under simple restrictions the exact size of a test when variance heterogeneity is present. Further modification of the technique has been utilized to obtain the exact power of the tests. A method of extending the techniques to the case of more than two variables is also considered.

Maryland U., College Park.
EXTREMAL PROBLEMS IN THE CLASS OF STARLIKE FUNCTIONS, by James A. Hummel. Interim

technical rept. no. 33 on Fundamental Research in Applied Mathematics, Contract DA 36-034-ORD-1486. Feb 59, 27p. 5 refs. AD-211 950.
Order from LC mi$2.70, ph$4.80 PB 142 676

Maryland U., College Park.
INTEGRAL EQUATION FOR PRODUCTION PROCESSES, by J. Sucher and T. B. Day. Rept. on Contract AF 49(638)24. Jan 59, 15p. Physics Dept. Technical rept. no. 130; AFOSR TN-59-153; AD-211 113.
Order from LC mi$2.40, ph$3.30 PB 142 539

An integral equation is derived which exhibits directly the relation between an amplitude for production, including all interactions, and the corresponding amplitude for complete scattering between the initial particles alone, and between the final particles alone. The only non-measurable quantity involved in this relatively simple relation is shown to be an amplitude for "pure production" in which intermediate states with either the initial particles or the final particles are excluded.

Maryland U., College Park.
SOME CONSEQUENCES OF THE BOHR-MOLLERUP THEOREM, by Robert M. Sorenson. Interim technical rept. no. 36 on Fundamental Research in Applied Mathematics, Contract DA 36-034-ORD-1486. Apr 59, 52p. 19 refs. AD-217 072.
Order from LC mi$3.60, ph$9.30 PB 142 775

The theory of the Gammafunction frequently leads to the problem of showing that certain analytic expressions are identical with this function. In 1922, H. Bohr and F. Mollerup published a theorem which enables one to prove, in many cases, that a given expression is indeed the Gammafunction, without actually transforming it into a known expression. Artin has already demonstrated the usefulness of this theorem, and has developed a considerable portion of the theory of the Gammafunction from it. It will be the purpose of this paper, motivated by this theorem, and Artin's work, to investigate the Gammafunction, as a generalization of a real function, and to consider further ways in which the theorem may be used.

North Carolina U., Chapel Hill.
ON THE GREATEST DISTANCE BETWEEN TWO CHARACTERISTIC ROOTS OF A MATRIX, by Alfred Brauer and A. C. Mewborn. UNC Technical rept. no. 11 on Contract AF 18(603)38. Apr 59, 15p. 7 refs. AFOSR-TN-59-29; AD-208 874.
Order from LC mi$2.40, ph$3.30 PB 142 598

L. Mirsky in two recent papers has obtained upper and lower bounds for the greatest distance between two characteristic roots of matrices with only real roots and normal matrices. In this paper some of these results are improved and extended to arbitrary matrices using results of J. v. Sz. Nagy and T. Popoviciu on algebraic equations.

Oregon State Coll. [Corvallis]
LIMIT THEOREMS FOR THE DISTRIBUTIONS OF THE MAXIMA OF PARTIAL SUMS OF INDEPENDENT RANDOM VARIABLES, by Ernest G. Kimme. Technical rept. no. 1 on Functionals and Stockastic Processes, Contract AF 18(603)138. 1 Sep 57, 95p. 8 refs. AFOSR TN-58-720; AD-162 255.
Order from LC mi$5.40, ph$15.30 PB 139 398

Oregon State Coll., Corvallis.
A LIMIT THEOREM AND THE DISTRIBUTION OF THE STOCHASTIC INTEGRAL, by D. L. Clark. Technical rept. no. 2 on Functionals and Stochastic Processes, Contract AF 18(603)138. 1 Sep 57, 49p. 3 refs. AFOSR-TN-58-719; AD-162 254.
Order from LC mi$3.30, ph$7.80 PB 139 411

Parke Mathematical Labs., Inc., Carlisle, Mass.
ON THE EVALUATION OF INTEGRALS OF THE FORM $\int_{u_1}^{u_2} F(u)e^{i\zeta(u)}du$, by P. J. Sally. Technical rept. no. 1 on Contract AF 19(604)3054. Aug 58, 52p. 8 refs. AFCRC TN-58-576; AD-117 002.
Order from LC mi$3.60, ph$9.30 PB 139 276

Pennsylvania U., Philadelphia.
DISTAL TRANSFORMATION GROUPS, by Robert Ellis. Rept. on Contract AF 18(600)1116. 29 Nov 58, 7p. 4 refs. AFOSR TN-58-181; AD-152 214.
Order from LC mi$1.80, ph$1.80 PB 139 309

Pennsylvania U., Philadelphia.
ON VARIATION DIMINISHING TRANSFORMATIONS OF THE CIRCLE, by J. C. Mairhuber, I. J. Schoenberg, and R. E. Williamson. Rept. on Contract AF 18(600)1158. July 59, 45p. 13 refs. AFOSR-TN-57-606; AD-136 595.
Order from LC mi$3.30, ph$7.80 PB 142 826

Princeton U. [N. J.]
THE BIRTH AND DEATH PROCESSES AS DIFFUSION PROCESSES, by William Feller. Rept. on Contract AF 18(603)24. [July 57] 58p. 11 refs. [AFOSR TN-57-354; AD-132 427]
Order from LC mi$3.60, ph$9.30 PB 138 473

The theory of the birth and death process is explained with emphasis on analytical methods; probabilistic interpretations and applications are briefly discussed. In analytic terms, the theory reduces to the construction of Markovian matrices such that each column satisfies an infinite system of differential equations and each row satisfies the adjoint system. The problem is treated by elementary methods without the benefit of any known results. A pair of adjoint diffusion equations are used which are analogous to the matrix form of the differential equations, and methods developed for second order differential operators are applied. A metric is introduced in the space E of states 0, 1, 2, . . . and the distance is used as the natural scale; a canonical measure is also introduced in E. Examples are cited for some cases, and probabilistic interpretations are given.

Purdue U., Lafayette, Ind.
ON TOEPLITZ MATRICES, ABSOLUTE CONTINUITY AND UNITARY EQUIVALENCE, by G. R. Putnam. Technical note no. 8 on Commutators on a Hilbert Space, Contract AF 18(603)139. May 59, 14p. 13 refs. AFOSR TN-58-618; AD-162 147.
Order from LC mi$2.40, ph$3.30 PB 142 617

RIAS, Baltimore, Md.
RECENT SOVIET CONTRIBUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS AND NONLINEAR MECHANICS, by Joseph P. LaSalle and Solomon Lefschetz. Rept. on Contract AF 49(638)382. Apr 59, 64p. 19 refs. Technical rept. 59-3; AFOSR-TN-59-308; AD-213 092.
Order from LC mi$3.90, ph$10.80 PB 142 510

This report is an appraisal of recent Soviet contributions to differential equations and nonlinear mechanics. It contains a general appraisal of the significance and implications of Soviet research in this field. A somewhat nontechnical description is given of the major areas of research and the significance of individual Soviet contributions. As an appendix to this report we have included a more technical appraisal of the Soviet contributions. A mathematical abstract together with the names of the authors and exact references are given in this appendix of each of the major papers and books available to us in 1958. Papers which appear to be of undoubted practical importance are designated by the letter P. The letters HG indicate that we have judged the work to be an outstanding scientific contribution.

Statistical Lab., U. of California, Berkeley.
SOME EARLY INSTANCES OF CONFIDENCE STATEMENTS, by E. L. Lehmann. Technical rept. no. 5 on Contract Nonr-222(43). Sep 58, 24p. 15 refs.
Order from LC mi$2.70, ph$4.80 PB 142 514

A general theory for obtaining limits within which an unknown parameter can be asserted to lie with known probability was developed by Fisher and Neyman in the 1930's. The basic device through which such limits are obtained consists in "solving" a probability statement which involves an unknown parameter $\theta$, for this parameter. The resulting statement concerning $\theta$ is then equivalent to the original statement and thus holds with the same known probability.

Virginia U., Charlottesville.
HANKEL MATRICES AND LINEAR FUNCTIONALS ON HARDY SPACES, by Marvin Rosenblum. Technical note no. 8 on Contract AF 49(638)72. Oct 58, 17p. 10 refs. AFOSR TN-58-1028; AD-162 295.
Order from LC mi$2.40, ph$3.30 PB 139 321

Virginia U. [Charlottesville]
OPEN MAPPINGS ON 2-DIMENSIONAL MANIFOLDS, by G. T. Whyburn. Technical note 10 on Topology and Mathematical Analysis, Contract AF 49(638)72. June 59, 30p. 5 refs. AFOSR[TN]59-581; AD-217 028.
Order from LC mi$2.70, ph$4.80 PB 142 732

## Computing Devices

Air Force Cambridge Research Center, Bedford, Mass.
AN AIRBORNE TRANSISTORIZED AUTOMATIC BINARY-CODE ERROR DETECTOR AND COUNTER UNIT FOR EVALUATING AN EXPERIMENTAL COMMUNICATION SYSTEM, by John A. DiGiorgio. Jan 59, 16p. AFCRC-TR-59-109; AD-210 217.
Order from LC mi$2.40, ph$3.30 PB 142 825

The binary-code error detector will accept a sequence of four preselected binary codes at a 1-kcps rate and make an evaluation of the reliability of transmission over a communication system. The binary-code scheme is received from a five-channel airborne communication receiver along with a synchronization pulse. An internal 100-kcps gated oscillator generates the timing pulses.

Air Force Cambridge Research Center, Bedford, Mass.
SOME INTRODUCTORY NOTES ON APPLICATIONS OF LINEAR AND DYNAMIC PROGRAMMING TO COMMUNICATION PROBLEMS, by David Middleton. Jan 59, 25p. 8 refs. AFCRC TR-59-101; AD-211 476.
Order from LC mi$2.70, ph$4.80 PB 142 471

A number of examples show how the recently developed methods of linear and dynamic programming can be applied to problems in the communication field, particularly to those of large-scale communication networks consisting of many individual links.

Convair, Fort Worth, Tex.
DIGITAL PULSE INTEGRATOR, by B. A. Kelly. Rept. on Contract AF 33(600)32054. 28 Dec 58, 41p. 4 refs. NARF-58-52T; MR-N-191.
Order from LC mi$3.30, ph$7.80 PB 142 484

A digital pulse integrator system has been developed. This system makes possible the accurate measurement of integrated pulse amplitudes from any source without regard to its integral bias curve, if the ratio of maximum to minimum pulse heights falls within a 20:1 range. The system consists of a commercially built linear amplifier, a Convair-built analog-to-digital converter and power supply, and a commercially built data storage and readout unit. The system is linear for converter input pulses of from 5 to 90 volts amplitude and will resolve 1.25-volt variations in the amplitude of these pulses. The system accepts pulses of random height and time distribution and registers counts numerically proportional to the amplitude of the pulses. These counts are then stored and displayed in a scaler.

David Taylor Model Basin, Washington, D. C.
FRAMEWORKS I AND II: AUTOMATIC PROGRAMMING SYSTEMS FOR UNIVACS I AND II, by Arthur Shapiro. Aug 58, 54p. 1 ref. Rept. 1232.
Order from LC mi$3.60, ph$9.30 PB 142 518

Frameworks I and II are automatic programming systems designed for the UNIVAC, a high-speed electronic digital computer. This report contains a detailed description of the capabilities and limitations of the systems, and full directions on how to use them.

International Business Machines Corp., Yorktown Heights, N. Y.
THE USE OF THE IBM 704 IN THE SIMULATION OF SPEECH RECOGNITION SYSTEMS, by G. L. Shultz. Final rept. for 1 July 56-31 Dec 57 on Contract Nonr-2101(00). 1 Jan 58, 26p. Research rept. RC-37.
Order from LC mi$2.70, ph$4.80 PB 142 585

The first step in mechanical speech recognition involves the analysis of a large number of speech sounds to determine the characteristics by which these sounds may best be discriminated. To accomplish this analysis special advantage is taken of techniques made possible by the advent of the large scale digital computer. This paper describes the equipment required to both facilitate editing samples of sounds for analysis and convert these sounds to digital form suitable as computer inputs. A system of programs is presented and the feasibility of the computer as a research tool is illustrated.

Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y.
THE DIODE-MATRIX CODER, by William A. Bellmer. Rept. on Contract Nonr-839(05). 19 May 58, 62p. 5 refs. Research rept. R-659-58; PIB-587.
Order from LC mi$3.90, ph$10.80 PB 142 555

A pulse-operated digital device is designed to code and decode serial signals with a variety of codes, to count, and to act as a shift register. Plug-in transistorized memory units and a rectangular array (matrix) of plug-in crystal diodes are used to enable changes to be quickly and easily made from one type of operation to another. Since the device must use non-ideal components, a maximum size limit is defined by the circuit parameters; this limits the complexity of the operation to be performed. Relations are therefore derived between the code complexity, the number of memory units and diodes in the matrix, and the quality of the transistors and diodes. The results obtained from the designed circuitry indicate a complexity limit of decimal counting, four-digit register, or 5:1 compression coding. The use of higher-quality components should increase the capabilities of the device considerably.

Naval Research Lab., U. of Wisconsin, Madison.
DIGITIZED DESCRIPTION PROCESSING. PART I. ELEMENTARY CONSIDERATIONS, by M. P. Barnett. Rept. on Contract N7onr-28511. 27 Jan 58, 48p. WIS-ONR-28.
Order from LC mi$3.30, ph$7.80 PB 139 326

Programming systems are discussed, for the automatic processing, by the computor, of the coded descriptions of mathematical and logical procedures. It is suggested that by the provision of certain programming programmes, which could be developed without too much difficulty, the computor could be used to build up its repertoire of useful programmes by the further input of very concise statements of operational procedures.

Naval Research Lab., Washington, D. C.
GREAT CIRCLE CALCULATIONS BY DIGITAL COMPUTER, by B. E. Trotter. Interim rept. 31 July 59, 15p. 1 ref. NRL rept. 5330.
Order from LC mi$2.40, ph$3.30 PB 140 185

A 12-track program (excluding standard subroutines) which performs great circle calculations, required in connection with direction finding, radio propagation, and navigation problems, has been written for the LGP-30, a small, general-purpose digital computer. The program is characterized by simplified input and concise, unambiguous output.

Servomechanisms Lab., Mass. Inst. of Tech., Cambridge.
EVALUATION OF FIRE-CONTROL SYSTEM ACCURACY, by D. T. Ross and D. F. McAvin. Volume 3 of 3 on Data Reduction Programming for Pre-B-58 Tests of the XMD-7 Fire-Control System, Contract AF 08(603)4324. Dec 58, 187p. Rept. 7886-R-3; APGC TR-58-141(III); AD-207 353.
Order from LC mi$8.40, ph$28.80 PB 142 530

Complete derivations of all equations used for the evaluation of the XMD-7 Fire-Control System are presented in Volume 3. (See also PB 142 531)

Servomechanisms Lab., Mass. Inst. of Tech., Cambridge.
FUNCTIONAL DESCRIPTION OF THE DATA REDUCTION SYSTEM, by D. T. Ross. Volume 1 of 3 on Data Reduction Programming for Pre-B-58 Tests of the XMD-7 Fire-Control System, Contract AF 08(603)4324. Dec 58, 54p. 4 refs. Rept. 7886-R-1; APGC TR-58-141(I); AD-207 351.
Order from LC mi$3.60, ph$9.30 PB 142 532

Flight testing of airborne fire-control systems in mock combat against an actual target presents a data collection and data reduction problem of great magnitude. Most of the techniques used in the Pre-B-58 Data Reduction System can serve as a model for other applications. The functions of and relationships between the various major programs of the Pre-B-58 Data Reduction System are outlined in Volume I.

Servomechanisms Lab., Mass. Inst. of Tech., Cambridge.
INITIAL DATA PROCESSING, by B. H. Scheff. Volume 2 of 3 on Data Reduction Programming for Pre-B-58 Tests of the XMD-7 Fire-Control System, Contract AF 08(603)4324. Dec 58, 156p. Rept. 7886-R-2; APGC-TR-58-141(II); AD-207 352.
Order from LC mi$7.50, ph$24.30 PB 142 531

Volume 2 describes the extensive, sophisticated data editing functions which are performed by the Initial Data Processing Program (IDPP). (See also PB 142 532)

Willow Run Labs., U. of Michigan, Ann Arbor.
EXPONENTIALLY MAPPED PAST STATISTICAL VARIABLES, by Joseph Otterman. Rept. on Proj. Michigan, Contract DA 36-039-sc-78801. June 59, 19p. 4 refs. Rept. no. 2900-6-T.
Order from LC mi$2.40, ph$3.30 PB 142 781

This report presents an approach to the analysis of data by an analog computer or a digital computer. This approach is thought useful and appropriate for battlefield-surveillance problems. In the constantly changing picture of battlefield conditions, interest is focused on recent events. Exponentially mapped past (e. m. p.) statistical variables are quantities relating to a set of observations computed in such a way that the recent values of the observations contribute more strongly than the values observed in the more distant past. The relative weighting is a geometrical ratio in the case of discrete (naturally discrete or sampled) data and an exponential function in the case of continuously observed functions. Definitions of some e. m. p. variables are introduced and certain simple relationships are discussed. The distinct computational advantages of the e. m. p. variables are pointed out.

## MECHANICS

Bolt, Beranek and Newman, Inc., Cambridge, Mass.
FLEXURAL VIBRATION DAMPING OF MULTIPLE-LAYER PLATES, by Donald Ross, Edward M. Kerwin, Jr., and Ira Dyer. Rept. on Contract Nonr-2321(00). 26 June 58, 63p. 15 refs. Rept. no. 564.
Order from LC mi$3.90, ph$10.80 PB 142 551

When homogeneous damping layers are applied on one or both sides of the plate, the damping mechanism is associated with the alternating extensional strain of the visco-elastic damping material. The damping achieved is roughly proportional to the product of the Young's modulus and the square of the thickness of the damping layer.

Brown U. Div. of Applied Mathematics, Providence, R. I.
MINIMUM WEIGHT DESIGN OF STEEL FRAMED STRUCTURES UNDER SHAKEDOWN LOADING, by Jacques Heyman. Technical rept. no. 34 on Contract Nonr-562(10). Mar 58, 37p. 5 refs. C11-34.
Order from LC mi$3.00, ph$6.30 PB 139 386

The minimum weight design of framed structures under both fixed and independently varying loads is discussed. An iterative method is presented for the minimum weight design of a frame of any degree of complexity.

Brown U. Div. of Applied Mathematics, Providence, R. I
SYSTEMATIC PLASTIC ANALYSES OF PLANE FRAMES, by Joseph Panarelli. Technical rept. no. 33 on Contract Nonr-562(10). Mar 58, 33p. 18 refs. C11-33.
Order from LC mi$3.00, ph$6.30 PB 139 252

The conventional analysis of indeterminate structures is restricted to the elastic range. A structure of ductile material such as mild steel, however, remains serviceable long after the elastic limit has first been reached at some section of the structure. Plastic or limit analysis enables the engineer to utilize these properties and hence to design more rationally and economically than by elastic methods.

Brown U. Div. of Engineering, Providence, R. I.
BUCKLING OF AN ELASTOPLASTIC COLUMN SUBJECTED TO AXIAL LOAD AND A TRANSVERSE TEMPERATURE GRADIENT, by Sol R. Bodner. Technical rept. no. 8 on Contract Nonr-562(20). Sep 58, 30p. 4 refs. Nonr-562(20)/8.
Order from LC mi$2.70, ph$4.80 PB 142 456

An approximate solution is obtained for the buckling of an elastoplastic column that is clamped at both ends and is subjected to axial load and a transverse temperature gradient. The temperature gradients considered are sufficiently severe so that compressive yielding takes place over part of the column cross section prior to buckling. The buckling load is obtained by an energy method in which functions are chosen to represent the deflected shape. It is shown that partial yielding of the column due to the temperature gradient can have an appreciable effect on lowering the buckling strength.

Columbia U., New York.
VIBRATIONS OF AN INFINITELY LONG CYLINDRICAL SHELL IN A SEMI-INFINITE ACOUSTIC MEDIUM, by Donald J. Butler. Technical rept. no. 21 on Contract Nonr-266(08); technical rept. no. 3 on Contract Nonr-266(27). May 58, 41p. 11 refs. CU-21-58-ONR-266(08)CE; CU-3-58-ONR-266(27)-CE.
Order from LC mi$3.30, ph$7.80 PB 139 462

The wide interest in problems of vibrations of thin shells has recently led to studies concerning the free and forced vibrations of shells submerged in an acoustic medium. In addition to essentially acoustic questions, there has been strong interest in the structural response and frequencies of vibration of such shells, as may be seen from the literature. These studies have particularly dealt with metal shells submerged in water. The present paper is primarily concerned with the structural aspects of such a problem. It considers the free and forced vibrations of an infinitely long cylindrical shell submerged in an inviscid acoustic medium, i. e., one whose motions conform to the linear theory of waves of expansion.

Illinois Inst. of Tech., Chicago.
THE DETERMINATION OF SAFE LOADS OF BEAMS SUBJECTED TO COMBINED BENDING, BENDING, AND TWISTING MOMENTS, by Philip G. Hodge, Jr. and R. Sankaranarayanan. Rept. on Contract Nonr-1406(04). Apr 58, 37p. 6 refs. DOMIIT rept. no. 1-2.
Order from LC mi$3.00, ph$6.30 PB 139 366

Using the lower bound theorem of limit analysis a yeild criterion is obtained in terms of the stress re-

sultants for a beam subjected to combined bending, bending, and twisting moments. Based on a piecewise linear approximate yeild condition, the "collapse load" is determined for a right angle bent, subjected to a load in an arbitrary direction applied to the midpoint of one leg. Such a collapse load, which is a "safe load" for the beam is plotted as a function of a suitable parameter.

Michigan U. Research Inst., Ann Arbor.
RESPONSE OF SHALLOW VISCOELASTIC SPHERICAL SHELLS TO TIME-DEPENDENT AXISYMMETRIC LOADS, by P. M. Naghdi and W. C. Orthwein. Technical note no. 4 on Contract AF 18(603)47. Nov 58, 26p. 18 refs. 2500-5-T; AFOSR TN-58-993; AD-205 905.
Order from LC mi$2.70, ph$4.80 PB 139 402

The present paper is concerned with the response of shallow viscoelastic spherical shells to arbitrary time-dependent axisymmetric loads; the medium is assumed homogeneous and isotropic. Although emphasis is placed on unlimited shallow spherical shells, shallow spherical shell segments are also considered and discussed in Sec. 7. The solutions, employing the differential equations governing the transverse motion of thin shallow elastic shells, are obtained with the joint use of the Laplace and the Hankel transforms which, by interchanging the order of the inversions, avoids an otherwise intricate task of contour integration in the complex Laplace transform-plane.

Minnesota U., Minneapolis.
DAMPING ENERGY DISSIPATION AT SUPPORT INTERFACES OF SQUARE PLATES, by T. J. Mentel and C. C. Fu. Rept. for July-Dec 58 on Materials Analysis and Evaluation Techniques, Contract AF 33(616)5426. June 59, 29p. 4 refs. WADC Technical rept. 59-96; AD-216 530.
Order from OTS $0.75 PB 151 972

The energy dissipation due to viscous shear forces between support interfaces of built-in square plates is obtained for simple harmonic transverse vibration of the plates. A comparison is made with the energy dissipation due to material damping within the plates and it is shown that the interface damping mechanism can have an overriding effect for thin plates. A preliminary design curve is presented which allows rapid evaluation of structural and material parameters which will maximize interface damping.

Pennsylvania State U., University Park.
SCABBING AND PULSE PROPAGATION IN MATERIALS, by Sudhir Kumar. Doctoral thesis. Interim technical rept. no. 14 on Scabbing and Fracture of Materials by Stress Waves, Contract DA 36-061-ORD-465. 1 Aug 58, 120p. 38 refs.
Order from LC mi$6.00, ph$18.30 PB 142 683

Contents:
Introduction
Survey of past work in the field
Elementary elastic analysis of scabbing
Applied aspects of scabbing
Elasto-plastic wave propagation in uniaxial stress and the stress jump method
Strain contour method

Princeton U., N. J.
STATISTICAL DISTRIBUTION OF SOLID PHASE IN TWO-PHASE TURBULENT MOTION, by S. L. Soo and Richard L. Peskin. Rept. on Contract Nonr-1858(25). May 58, 56p. 25 refs. Proj. Squid Technical rept. PR-80-R.
Order from LC mi$3.60, ph$9.30 PB 142 524

The motion of small particles transported by a homogeneous non-decaying turbulent fluid is treated as a typical example of a two phase system. The fluid phase is described statistically using the concept of the Lagrangian spectrum of turbulence. A concept of particle phase-fluid phase interaction is proposed in which the particle is acted upon not by only one sequence of random fluid velocity components, but by various random velocity sequences which the particle may encounter as determined by some selection law based on probability. An expression for the particle-field selection law is obtained, and the stochastic differential equation of motion is integrated to give an expression of the probable particle velocity in terms of the Fourier components of the fluid velocity. An approximate form of the frequency distribution of Fourier components of the fluid velocity is used to obtain an expression for the frequency distribution of the Fourier components of the particle velocity as well as an expression for particle intensity in terms of the relative Reynolds number and a particle size parameter.

University of Southern California, Los Angeles.
SOME PROBLEMS IN HYDROMAGNETICS, by K. P. Chopra. Rept. on Contract AF 18(603)95. 31 Jan 59, 220p. 41 refs. USCEC rept. 56-205; AFOSR TN-59-265; AD-212 468.
Order from LC mi$9.60, ph$33.30 PB 142 687

Contents:
General introduction
Induction drag of a sphere moving in a conducting fluid in the presence of a magnetic field
Hydromagnetic flow in a circular pipe
Magnetic fields in a conducting fluid sphere and infinite cylinder with electric currents flowing in them
Change in energy of a magnetic sphere under a $P_1$-deformation. (equilibrium configurations of the sphere)
Radial adiabatic pulsations of an infinite cylinder in the presence of a magnetic field
Tunnel effect in hydromagnetics
Compressible hydromagnetics

## Aerodynamics and Pneumatics

Brown U. Div. of Applied Mathematics, Providence, R. I.
AERODYNAMIC FORCES ON A CYLINDRICAL SHELL IN PANEL FLUTTER, by Maurice Holt. Rept. on Contract AF 49(638)232. Dec 58, 17p. 8 refs. AFOSR TN-58-974; AD-205 598.
Order from LC mi$2.40, ph$3.30 PB 139 403

The aerodynamic forces resulting from the unsteady distortion of a circular cylinder of finite length, in a

uniform supersonic stream, are determined. The problem is very similar to that of finding the steady flow past a quasi cylindrical duct. This has recently been solved by Randall in terms of modified Bessel functions of the second kind. The forces on the finite cylinder are compared with corresponding forces on an infinite cylinder, which have been used previously in cylindrical panel flutter analyses. In the case of infinite length circumferential distortion introduces a constant factor into the expression for the surface pressure. On the other hand, on a cylinder of finite length, circumferential distortion causes the surface pressure to be damped in the axial direction. The effect of finite length of cylinder should therefore be to improve panel flutter characteristics.

Brown U. Div. of Applied Mathematics, Providence, R. I.
UNSTEADY FREE BOUNDARY FLOWS THROUGH TWO-DIMENSIONAL NOZZLES, by D. Eisen and L. M. Milne-Thomson. Technical rept. no. 13 on Contract Nonr-562(07). Mar 58, 45p. 7 refs.
Order from LC mi$3.30, ph$7.80 PB 139 369

The problem of determining the initial and final stages of the unsteady free boundary of a jet of an ideal, incompressible fluid issuing from a two-dimensional orifice formed by two semi-infinite plates, each perpendicular to the central axis of the ultimately steady jet, has been discussed by Curle. The purpose of this paper is to study the case where the plates are no longer perpendicular to the central axis of the jet but are still symmetrically disposed.

Combustion Aerodynamics Lab., Harvard U., Cambridge, Mass.
TABULATION OF THE BLASIUS FUNCTION WITH BLOWING AND SUCTION, by H. W. Emmons and D. Leigh. Interim technical rept. no. 9 on Contract DA 19-020-ORD-1029. Nov 53, 84p. 5 refs.
Order from LC mi$4.80, ph$13.80 PB 142 613

For a non-porous plate the third boundary condition is $v(0) = 0$ at $\eta = 0$ or $f(0) = 0$ at $\eta = 0$. In the case of a porous wall through which fluid is being blown or sucked, the normal velocity component v is not zero. Only in the case of $v(0, x)$ proportional to $x^{-1/2}$, as required by equations (2) or (6), is the boundary layer problem reducible to that of Blasius equation. Such inverse half power blowing or suction distribution is only conveniently attained if the normal surface velocity is controlled by the boundary layer itself through its mass and heat transfer properties. It was in connection with the solution of a combustion problem that the present solutions were obtained.

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
GASDYNAMICS OF A WAVE SUPERHEATER FACILITY FOR HYPERSONIC RESEARCH AND DEVELOPMENT, by R. C. Weatherston, A. L. Russo and others. Rept. for Nov 56-May 58 on Contract AF 18(603)141. Feb 59, 147p. 34 refs. Rept. no. AD-1118-A-1; AFOSR-TN-59-107; AD-210 223.
Order from LC mi$7.20, ph$22.80 PB 142 603

This report treats the wave superheater, a unique device to produce a continuous, supersonic flow of uncontaminated air or other gases at temperatures and pressures needed for realistic hypersonic testing in the laboratory. The fundamental principles of wave superheater design and operation are developed. In particular, the gasdynamic and heat transfer aspects of one version, which is designed to generate 9000°R in uncontaminated air, are discussed.

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.
THEORY OF THIN AIRFOILS IN FLUIDS OF HIGH ELECTRICAL CONDUCTIVITY, by W. R. Sears and E. L. Resler, Jr. Rept. on Contract AF 18(600)1523. Aug 58, 39p. 6 refs. AFOSR TN-58-973; AD-205 599.
Order from LC mi$3.00, ph$6.30 PB 139 404

Steady, plane flow of incompressible fluid past thin cylindrical obstacles is treated, with two different orientations of the undisturbed, uniform magnetic field; viz., parallel and perpendicular, respectively, to the undisturbed, uniform stream. In the first case, the flow of an infinitely conducting fluid is shown to be irrotational and current-free except for surface currents at the walls of the obstacles. With large but finite conductivity the surface currents are replaced by thin boundary layers of large current density. In the second case, for infinite conductivity the flow field is made up on an irrotational current-free part and a system of waves involving currents and vorticity extending out from the body. For large, finite conductivity these waves attenuate exponentially with distance from the body. In both cases the forces on sinusoidal walls and on airfoils are calculated.

David Taylor Model Basin, Washington, D. C.
EFFECT OF JET MIXING IN THE ANNULAR JET, by Harvey R. Chaplin. Feb 59, 32p. 3 refs. Aero rept. 953.
Order from LC mi$3.00, ph$6.30 PB 142 523

The two-dimensional problems of the annular jet within and outside of ground effect are treated in detail. Augmentation factor and critical altitude are found to depend on nozzle area ratio, pressure ratio, and temperature ratio, in addition to the parameters affecting the nonmixing annular jet. With proper interpretation, the two-dimensional solution furnishes a good approximation to the equivalent solution for the axially symmetric annular jet within ground effect. It furnishes a rough idea of the equivalent solution for the axially symmetric annular jet outside ground effect. The results indicate that the mixing has important adverse effects on annular jets employing narrow nozzles and high pressure ratios.

Heat Transfer Lab., Mass. Inst. of Tech., Cambridge.
THE EFFECT OF FREE-STREAM OSCILLATIONS ON THE LAMINAR BOUNDARY LAYERS ON A FLAT PLATE, by Richard J. Nickerson. Rept. on Contract AF 33(616)3157. Dec 58, 95p. 27 refs. WADC Technical rept. 57-481; AD-210 477.
Order from OTS $2.25 PB 151 942

The effect of harmonic oscillations in the magnitude of

the free-stream velocity on the laminar velocity and temperature boundary layers on a flat plate is analyzed. The analysis predicts a negligible change in the steady rate of heat transfer from the plate surface. The analysis shows that for large enough values of the dimensionless variable $x\omega/U_\infty$, the flow pattern is a simple superposition of the steady flow plus the oscillating flow. Experimental velocity profiles obtained with a hot-wire anenometer are presented and show reasonably good agreement with the theory. Heat transfer measurements indicate no change in the steady rate of heat transfer for frequencies up to 10 cycles per second and amplitudes of oscillation of about 25 percent.

Hydrodynamics Lab., Mass. Inst. of Tech., Cambridge.
STUDIES ON THE VALIDITY OF THE HYDRAULIC ANALOGY TO SUPERSONIC FLOW. PART V. TOWED MODEL INVESTIGATIONS OF TRANSONIC FLOW, by Harry E. Crosley, Jr. and Donald R. F. Harleman. Technical rept. no. 11 on Contract W33-039-ac-16703. Dec 52, 47p. 65 refs. USAF Technical rept. no. 5985, Pt. 5; AD-21 103.
Order from LC mi$3.30, ph$7.80 PB 142 669

The hydraulic analogy was applied to the study of transonic flow around wedge profiles. The analogous flows were produced by towing models through stationary water having an undisturbed depth of about 1 in. Most of the data were obtained by photographing the water line along the model surface; this method has an uncertain error of as much as ±5%. For steady transonic flows, the hydraulic results gave fair agreement with transonic small disturbance theory and good agreement with available results of comparable wind tunnel investigations. The results of these steady transonic flow studies verified the validity of the hydraulic analogy for this application. (See also PB 142 755)

Institute for System Research, U. of Chicago, Ill.
AERODYNAMIC STUDIES: THE FORCES ACTING ON AN AIR VEHICLE; A REVIEW OF THE LITERATURE [PART 21] by M. Z. Krzywoblocki. Rept. on Contract AF 33(616)2797. Jan 59, 262p. 1398 refs. WADC Technical note 56-360, Part 21; AD-161 019.
Order from OTS $4.00 PB-161 002

This work is an annotated bibliography of the scientific literature pertaining to methods of calculating the aerodynamic forces acting on an air vehicle in flight. The present segment of the work includes material reviewed by the author in the period January 1957 through March 1957. The more interesting papers and reports (from the viewpoint of the aerodynamicist) are discussed briefly; others are listed without comment. (See also PB 151 820)

Institute of Engineering Research, U. of California, Berkeley.
DESIGN CONSIDERATIONS AND INITIAL EVALUATION OF MODEL B PLASMA GENERATOR, by W. Lai, J. Gustavson and L. Talbot. Technical rept. on Contract Nonr-222(45). 5 Sep 58, 14p. 3 refs. Rept. no. HE-150-161; Series no. 20, issue no. 123.
Order from LC mi$2.40, ph$3.30 PB 142 136

The design and initial testing of a d-c arc plasma generator to be used as a source of high temperature gas for a low density wind tunnel was previously described The tests conducted with this plasma generator, "Model A", showed it to possess a number of undesirable characteristics. The present report describes an improved model, designated "Model B".

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE USE OF AZOBENZENE TO PROVIDE A VISUAL INDICATION OF SUPERSONIC-BOUNDARY-LAYER TRANSITION, by Patrick J. Rygh and Robert E. Martin. Rept. on Contract DA 04-495-ORD-18. 15 Oct 57, 15p. 3 refs. Progress rept. no. 20-335.
Order from LC mi$2.40, ph$3.30 PB 142 757

A method of determining the supersonic-boundary-layer transition position on a model surface by means of a subliming solid is discussed. The validity of the method and the parameters governing its use are established.

Johns Hopkins U., Baltimore, Md.
THE BEHAVIOR OF TURBULENT BOUNDARY LAYERS, by Francis H. Clauser. Rept. on Contract AF 18(600)671. 25 Feb 54, 36p. 6 refs. AFOSR-TN-54-328; AD-48 122.
Order from LC mi$3.00, ph$6.30 PB 142 546

A review is presented of established work on turbulent boundary layers. The concept of the equilibrium layer is introduced, and a discussion is given of a number of ways in which a boundary layer can be disturbed. Experiments showed that (1) when the boundary layer passes through a changing environment, the layer is in a disturbed condition, and (2) when the environment of the boundary layer is held constant, the layer approaches a natural state appropriate to that environment. An experiment is described in which the skin friction in a conventional constant-pressure layer on a smooth plate was abruptly increased by roughening the wall with corrugated paper. The experiment showed that the region next to the wall is affected first, and that the change propagates outward until the entire profile is shifted over to a new curve. No rescaling of the variables is possible which can cause the profile to have the same shape as in the equilibrium zones ahead of or behind the transition zone. Experiments are described for the measurement of the time required for a boundary layer to return to equilibrium after it has been distrubed (the response time of the boundary layer). The problem of the nonequilibrium behavior of the outer portion of the layer is discussed. (Presented at the second Canadian Symposium of Aerodynamics, University of Toronto, February 25, 1954)

Massachusetts Inst. of Tech., Cambridge.
STUDIES ON THE VALIDITY OF THE HYDRAULIC ANALOGY TO SUPERSONIC FLOW, PART III, by A. T. Ippen and D. R. F. Harleman. Rept. on Contract W33-038-ac-16703. Oct 50, 52p. 10 refs. AF Technical rept. no. 5985, pt. 3; ATI-110 693.
Order from LC mi$3.60, ph$9.30 PB 142 759

Division A: Fundamental flow expansion zones of the Prandtl-Meyer type are investigated experimentally in

a high velocity water channel. Free surface flows for various expansion angles simulating air streams at Mach numbers of 1.95 and 2.94 are compared with the corresponding results obtained from the hydraulic and aerodynamic theories. Division B: The hydraulic analogy is applied to the circular-arc and the half-diamond airfoils in steady, two-dimensional supersonic flow. Airfoil pressure distributions together with coefficients of lift, drag, and moment are computed for various angles of attack using (1) the hydraulic theory and (2) the modified analogy developed in part II of this report. Division C: A shadowgraph photographic technique is presented which results in clear pictures of shock wave patterns. The scale of the tests are such that capillary effects are negligible.

Massachusetts Inst. of Tech., Cambridge.
STUDIES ON THE VALIDITY OF THE HYDRAULIC ANALOGY TO SUPERSONIC FLOW [PART IV] by Donald R. F. Harleman and Harry E. Crossley, Jr. Rept. on Contract W33-038-ac-16703. Feb 52, 53p. 14 refs. AF Technical rept. no. 5985, pt. 4; ATI-160 258.
Order from LC mi$3.60, ph$9.30 PB 142 755

Division A: The characteristics of the supercritical flow water channel were investigated with respect to Froude (Mach) number range, Reynolds number range, and variation of Froude number in the test area. Division B: Limitations to the application of the hydraulic analogy to airfoil-like models were studied. In particular, the following results were found: (1) shock transition length, or "thickness", is approximately proportional to free-stream Reynolds number and necessitates use of large models for satisfactory results; (2) at low Frounde numbers (1.5 - 2.5) and low Reynolds numbers, short airfoils can be tested at high ($\pm 30^{o}$) angles of attack without channel choking; (3) flow separation is negligible in the cases studied; (4) shock detachment is considerable delayed for the asymmetric case of thin airfoils at high angles of attack. Division C: The stereophotogrammetric mapping of the water surface in the channel was investigated and shows considerable promise as a solution to the problem of depth measurement in unsteady flows. Division D: Supplementary apparatus was developed for towing models in the water channel. Division E: The addition of a wetting agent to the water to reduce capillarity enabled studies to be carried out with small towed wedge models in transonic flow. It was found that depth distributions at boundary surfaces could be obtained photographically. (See also PB 142 759)

Massachusetts Inst. of Tech., Cambridge.
THE THREE-DIMENSIONAL LAMINAR BOUNDARY LAYER ALONG A CORNER, by Richard A. Oman. Doctoral thesis. Technical rept. no. 1 on Contract DA 19-020-ORD-4538. Jan 59, 144p. 19 refs. AD-211 216.
Order from LC mi$7.20, ph$22.80 PB 142 543

The problem of laminar incompressible boundary layer flow along two perpendicular intersecting planes is considered for the case of arbitrary streamwise pressure gradient. Experimental velocity distributions are presented for favorable, unfavorable, and zero pressure gradients. These were taken at the intersection of two walls of a square glycerin-water boundary layer tunnel. A momentum integral type of analysis is formulated for the case of a semi-infinite corner boundary layer, and also for a corner boundary layer in a square channel. The theoretical treatments of these two cases show important differences due to changed boundary conditions on the transverse velocity components.

North American Aviation, Inc., Los Angeles, Calif.
AN ANALYTICAL STUDY OF THE DYNAMICS OF SPINNING AIRCRAFT. PART I. FLIGHT TEST DATA ANALYSES AND SPIN CALCULATIONS, by John H. Wykes, Gilbert R. Casteel, and Richard A. Collins. Rept. on Analytical Study of the Dynamics of Spinning Aircraft, Contract AF 33(616)5285. Dec 58, 229p. 26 refs. WADC Technical rept. 58-381, Pt. 1; AD-203 788.
Order from OTS $3.50 PB 151 917

This report presents the results of a study designed to show the feasibility of avoiding current limitations of spin test facilities by the use of an analytical approach to predicting spin characteristics. Analyses of flight test data were made to show the relative importance of weight, inertia, engine and aerodynamic influences acting during a spin of a typical fighter airplane. The effects of the aerodynamic factors are shown to be highly important. Problems encountered during low speed wind tunnel tests to obtain applicable aerodynamic stability and control data are discussed, including tunnel blockage at high angles of attack, Reynolds number effects, and the use of grit tripping to obtain simulated high Reynolds number data. No dynamic model was tested for rotary derivatives, but a "strip" technique was developed which gives first order of magnitude influences. Both the static and rotary derivative data were used in a number of six degrees of freedom spin calculations. These spin calculations were evaluated by comparing them against flight test data. These comparisons show that it is possible to calculate the response characteristics of an airplane through all phases of the spin from the incipient phase through recovery. Also, a comparison between a high Mach number spin entry calculation and flight test data was made. It was indicated that if good data are available, the calculating techniques used to study low speed spins are also applicable to high speed maneuvers with slight modification. The possibility of utilizing these techniques to study space vehicle re-entry dynamics is pointed up.

North American Aviation, Inc., Los Angeles, Calif.
AN ANALYTICAL STUDY OF THE DYNAMICS OF SPINNING AIRCRAFT. PART II. WIND TUNNEL TESTS, by John H. Wykes, Gilbert R. Casteel, and Richard A. Collins. Rept. on Analytical Study of the Dynamics of Spinning Aircraft, Contract AF 33(616)5285. Dec 58, 69p. 2 refs. WADC Technical rept. 58-381, Pt. 2; AD-203 789.
Order from OTS $1.75 PB 151 918

The results of a series of low-speed-wind-tunnel-force tests of the F-100D from 0 to $90^{o}$ angle of attack and sideslip angles of $0^{o}$ to $20^{o}$ are presented. These data were obtained to support an attempt to calculate the spinning characteristics of the airplane. These data include configuration buildup and control effectiveness data. In addition, the effects of Reynolds number and

the effect of tripping the fuselage boundary layer to simulate high Reynolds number flow were investigated. A simple but effective way of correcting data for tunnel blockage effects when a model is at high angles of attack is also presented. (See also PB 151 917)

Rosemount Aeronautical Labs., U. of Minnesota, Minneapolis.
EXPERIMENTAL INVESTIGATION OF LAMINAR HEAT TRANSFER WITH NONUNIFORM SURFACE TEMPERATURE AT M=4.3, by D. G. DeCoursin, R. E. Larson and N. C. Helm. Rept. on Contract AF 33(616) 3038. Jan 59, 70p. 19 refs. WADC Technical rept. 59-285; AD-216 300.
Order from OTS $1.75 PB 151 951

Measurements were made of local heat transfer in a laminar boundary layer with nonuniform surface temperature. The transient method of heat transfer measurement was used with a 20° total included angle cone model in a Mach number 5 stream. The cone surface Mach number was 4.3. Axial heat conduction due to surface temperature gradients was reduced by making the model from a laminated material composed of alternate layers of insulating cement and metal. The data were correlated with Lighthill's theory transformed to cone flow by the Mangler transformation. In applying the theory, the temperature distributions were approximated by linear segments. The agreement between theory and experiment was, for the most part, about ±10%.

Technion Research and Development Foundation, Ltd. (Israel).
FURTHER RESEARCH ON THE PHYSICS OF AIR VISCOSITY, by Markus Reiner. Technical rept. for 15 Feb-30 Sep 57 on Contract AF 61(514)964. [1958] 92p. 5 refs. AFOSR TN-58-454; AD-158 261.
Order from LC mi$5.40, ph$15.30 PB 139 196

## METALLURGY

Frankford Arsenal, Philadelphia, Pa.
IMPROVED SINTERED BRASS COMPACTS, by F. L. Zaleski and R. A. Powell. Feb 59, 25p. 8 refs. Technical rept. no. R-1503.
Order from LC mi$2.70, ph$4.80 PB 142 509

Substantially higher properties were obtained with sintered 70-30 brass compacts when lithium stearate, rather than the conventional zinc stearate, was used as the lubricant. The best properties were obtained with a lithium stearate addition of .50 and .75 per cent, a compacting pressure of 50 tons/sq inch (tsi), and a sintering atmosphere of nitrogen at 1600° of 1625° F. Preliminary studies have shown that improvements in properties can also be attained with the use of lithium stearate on compacts of copper, other copper base alloys, and iron.

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Francis M. Richmond. Progress rept. no. 1, 17 Mar-17 May 55, on Contract [NOas]55-517-C. 11 June 55, 14p. 4 refs.
Order from LC mi$2.40, ph$3.30 PB 142 605

In cobalt base alloys the following elements were selected for study. Mo, Nb, Al, Ti, Zr, B, and V.

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by R. W. Koffler, W. J. Pennington, and F. M. Richmond. Interim rept. no. 1, 4 Feb-4 Apr 57, on Contract NOas-57-448-C. 4 Apr 57, 29p. 1 ref. AD-134 932.
Order from LC mi$2.70, ph$4.80 PB 142 612

A second series of 16 heats consisting of a base composition of 0.005 wt.% boron, 0.05 wt.% zirconium, 2.0 wt.% iron and a ratio of cobalt:nickel:chromium of 50:30:20 wt. % with various amounts and combinations of titanium, aluminum, molybdenum, tungsten and niobium plus tantalum has been evaluated. The effect of increasing titanium and tungsten were found to be significantly beneficial and increasing aluminum contents detrimental to elevated temperature stress-rupture life. Two interactions, (Ti-Mo) and (Al-Nb+Ta), were determined to be detrimental to elevated temperature life. A third series of four heats was instigated to evaluate the effect of substituting tungsten for molybdenum, increasing the titanium from 2.0 to 4.0 wt. %, and the addition of 2.0 wt. % niobium plus tantalum. This series has not been fully evaluated. A fourth series consisting of four heats was designed to evaluate the effects of titanium contents in the range of 6.0 to 12.0 wt. %. The heats were melted but as yet no attempts have been made to forge the ingots. (See also PB 142 611)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Francis M. Richmond. Interim rept. no. 2, 17 May-17 July 55, on Contract [NOas]55-517-C. 16 July 55, 11p.
Order from LC mi$2.40, ph$3.30 PB 142 606

Seven air-melted heats containing from 10 to 40 atomic % "Equivalent Mo" have been melted. Upset tests on samples from these heats have been used to determine the correct forging temperatures. At the present time, three of these heats have been successfully forged to 3/4 inch square bars, and three others have been scrapped due to poor workability. These latter three heats will be remelted as soon as possible and new forging attempts will be made. (See also PB 142 605)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Francis M. Richmond. Interim rept. no. 3, 17 July-17 Sep 55, on Contract [NOas]55-517-C. 16 Sep 55, 23p.
Order from LC mi$2.70, ph$4.80 PB 142 607

Larson-Miller parameter curves have been plotted for most of the commercial alloys containing appreciable amounts of cobalt. (See also PB 142 606)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM. Interim rept. no. 4, 17 Sep-17 Nov 55, on Contract [NOas]55-517-C. 16 Nov 55, 17p.
Order from LC mi$2.40, ph$3.30 PB 142 608

All of the vacuum melted heats in this first series have been cast. Two air melted heats were cast as replacements for previously melted heats that were scrapped during the forging operation. Extensive forgeability tests are in progress on all heats cast. Four of the vacuum melted heats and two air melted heats have been forged to 3/4" bars and flattened to 3/8" paddles. Aging, tensile, and creep rupture tests are in progress on five of the heats melted in air and on one of the heats melted in vacuum. (See also PB 142 607)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Francis M. Richmond. Interim rept. no. 5, 17 Nov 55-17 Jan 56, on Contract [NOas] 55-517-C. 17 Jan 56, 15p.
Order from LC mi$2.40, ph$3.30 PB 142 609

Aging, tensile, and stress-rupture tests. Preliminary evaluations have been made. (See also PB 142 608)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Francis M. Richmond. Interim rept. no. 6 for 17 Jan-17 Mar 56 on Contract 55-517-C. 16 Mar 56, 28p.
Order from LC mi$2.70, ph$4.80 PB 142 610

The results indicated a significant effect from the substitution of Molybdenum for Aluminum and a linear effect of hardener level. (See also PB 142 609)

Universal-Cyclops Steel Corp., Bridgeville, Pa.
COBALT-BASE ALLOY AND MELTING PRACTICE DEVELOPMENT PROGRAM, by William J. Pennington and Robert W. Koffler. Interim rept. no. 7, 17 Mar-17 May 56, on Contract NOas-55-517-C. 17 May 56, 14p. 1 ref.
Order from LC mi$2.40, ph$3.30 PB 142 611

The series of heats to evaluate the effects of C, Ti, Al, Mo, W and Nb + Ta additions to cobalt base alloys

Materials Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
MECHANICAL PROPERTIES OF 17-7 PH AND PH 15-7 MO. STAINLESS STEEL, by Alton W. Brisbane. Rept. for Dec 56-Jan 58 on Materials Analysis and Evaluation Techniques. Jan 59, 38p. WADC Technical rept. 58-400; AD-208 322.
Order from OTS $1.00 PB 151 703

Tensile, compression and bearing data were obtained on these materials. Tensile stress-strain test results are presented for temperatures ranging from room temperature to 1000°F. A comparison is made between these two steels and AM-350 stainless steel 6Al-4V titanium strength-weight ratio wise. Strength-wise, the 17-7 PH and PH 15-7 Mo stainless steels are approximately the same to 800°F above this temperature PH 15-7 Mo is superior.

Naval Research Lab., Washington, D. C.
CRACK PROPAGATION TESTS OF HIGH-STRENGTH SHEET MATERIALS. PART III. LOW-ALLOY AIR-HARDENING STEEL, by J. E. Srawley and C. D. Beachem. 30 July 59, 16p. 5 refs. NRL rept. 5348.
Order from OTS $0.50 PB 151 770

The results of crack propagation tests, using center-cracked sheet tensile specimens, 0.5 inch wide and 0.075 inch thick, are presented for a proprietary, low-alloy, air-hardening steel (0.4% C, Cr-Mo-V), capable of being heat-treated to a tensile yield strength of at least 230 ksi. In this condition of highest strength the fracture-appearance transition temperature (FATT) was 200°F and the net fracture stress was much less than the yield strength at all temperatures in the range -200° to +500°F. Considerable improvements in these features were obtained by the use of two other tempering treatments, each of which resulted in a yield strength of slightly less than 200 ksi; however, the FATT was still above room temperature in each case. In addition to the tests with center-cracked specimens, some parallel tests were conducted with specimens in which slots with ends having radii of not more than 0.002 inch were used. A section of the report deals with the interpretation of the net fracture-stress values in relation to recent pertinent developments from the Griffith theory. (See also PB 151 352)

Naval Research Lab., Washington, D. C.
A REMOTELY OPERATED CHARPY TEST MACHINE FOR RADIOACTIVE SPECIMENS, by J. R. Hawthorne and L. E. Steele. Final rept. 13 July 59, 10p. Rept. no. 5305.
Order from LC $0.50 PB 151 636

Apparatus for the remote testing of standard Charpy V-notch specimens has been developed for the NRL Metallurgy Division Hot-Cell Facility. Specimens of various steels of interest for atomic-energy applications are tested in this facility after irradiation in materials testing reactors. With this apparatus, test temperatures within the range of -100° to 300°F can be attained. Heating and cooling are accomplished remotely by gas flow, thus eliminating the need for liquid temperature-control baths. Specimen temperature is measured continuously during the heating or cooling cycle by means of a thermocouple in contact with the specimen. Placement of the irradiated specimen in the test machine is accomplished automatically by pneumatic devices controlled by a synchronous programmer. With this system, approximately five seconds are required to test a specimen after it has been conditioned thermally.

Naval Research Lab., Washington, D. C.
SIMPLE LABORATORY BULGE TESTS FOR SHEET-METAL FRACTURE-TRANSITION STUDIES AND FOR WELDMENT PERFORMANCE EVALUATION, by P. P. Puzak and J. Stoop. Interim rept. 4 Aug 59, 18p. 8 refs. NRL rept. 5347.
Order from OTS $0.50 PB 151 771

Procedures and details are described for a simple and inexpensive fracture test developed for making fracture-transition studies and weldment-performance evaluations of high-strength sheet materials. The test is based on the use of rubber as a noncompressible fluid medium for transmitting the force of an impact blow to 6-in.-square specimens. The test is conducted in uniquely designed equipment void of complicated fixtures or gripping devices. Thus, after only brief instructions, skilled or semi-skilled technicians can evaluate rapidly numerous samples over a wide range of testing temperatures. Initial fracture-transition results are given for several steels and correlated with results obtained for these steels in other tests. The most significant use intended for the new test procedure is that of demonstrating potentially weak or brittle paths of failure in a weld assembly. The studies will be aimed at establishing the welding procedures, techniques, and materials required to insure trouble-free service in welded high-strength sheet-metal structures.

## Structural Metallurgy and Corrosion

Armour Research Foundation, Chicago, Ill.
DEVELOPMENT OF ULTRA-HIGH STRENGTH, TEMPER-RESISTANT STEELS DESIGNED FOR IMPROVEMENT OF FATIGUE PROPERTIES THROUGH RELIEF OF RESIDUAL STRESS, by Harvey B. Nudelman and John P. Sheehan. Rept. for 1 May 58-28 Feb 59 on Materials Analysis and Evaluation Techniques, Contract AF 33(616)3299. June 59, 32p. 7 refs. WADC Technical rept. 59-86.
Order from OTS $1.60 PB 151 971

Various experimental alloy steels were investigated with reference to temper resistance, which was evaluated on the basis of hardness measurements. Molybdenum was the major alloying element used for improving temper resistance in steels having carbon contents in the range of 0.30 to 0.55 per cent. Chromium, vanadium, and tungsten were utilized in minor amounts as alloying elements. It was found that austenitizing at 2200°F was required to dissolve all of the carbides and provide a fully martensitic structure upon oil quenching or air cooling. Alloys were developed capable of maintaining hardnesses of Rc 40 to Rc 59 after tempering for one hour in the range of 1250°F to 1300°F.

Detroit Arsenal, Center Line, Mich.
APPLICATION OF CATHODIC PROTECTION FOR THE PREVENTION OF ATMOSPHERIC CORROSION, by David K. Wilburn. 20 Jan 58, 32p. Rept. no. 4048 (Final); AD-156 373.
Order from LC mi$3.00, ph$6.30 PB 142 325

A series of controlled laboratory tests were conducted in a high humidity chamber to determine the effects of cathodic protection on selected test panels. Current density measurements associated with weight loss calculations provided a quantitative measure of corrosion attack. A modified cathodic protection method, employing a semi-conducting paint, in conjunction with a silver conducting paint, was investigated as a medium of current transfer relative to corrosion inhibition.

Martin Co. [Baltimore, Md.]
AUTOCLAVE TESTING OF TYPE 430 STAINLESS STEEL, by J. W. McGrew. Final rept. on Contract DA 44-009-eng-3043, Task 1, phase 2B, Jan 59, 26p. 15 refs. MND-E-1602; AD-209 930.
Order from LC mi$2.70, ph$4.80 PB 142 695

Stressed specimens of AISI Type 430 stainless steel were subjected to corrosive environments in rocker-type autoclaves at 400°F and 200 psi for periods generally of 120 hr duration. The most important environmental controls included the concentration of oxygen, chloride and phosphate. The pH was controlled between 8.5 and 11.5.

Naval Research Lab., Washington, D. C.
SOLIDIFICATION OF THE ALUMINUM-SILICON EUTECTIC, by R. A. Meussner. 31 July 59, 13p. 5 refs. NRL rept. 5346.
Order from OTS $0.50 PB 151 768

The eutectic solidification process in aluminum-silicon alloys has been examined through a metallographic study of slowly cooled and quenched specimens. The use of suitable etchants to delineate the structures of the Si and α phases and the examination of extracted particles of Si have shown that the abnormal Al-Si eutectic structure is the result of the great disparity in the nucleation and growth characteristics of the two phases. The eutectic Si not only nucleates readily, but it grows rapidly into a branched-plate structure. The nucleation of the α phase, requiring a high supersaturation, is retarded and, as a consequence, this phase exerts very little control in the solidification process. Thermal data, showing the relative effectiveness of the two primary phases in limiting the undercooling preceding the eutectic, support these observations.

Naval Research Lab., Washington, D. C.
THE STRUCTURE OF ALUMINUM-SILICON ALLOYS, by R. A. Meussner. 31 July 59, 25p. 13 refs. NRL rept. 5341.
Order from OTS $0.75 PB 151 760

The microstructures and the morphologies of the phases of unmodified Al-Si alloys have been examined through the use of special etchants and a chemical extraction technique. X-ray diffraction studies have been used to confirm the metallographic observations. Although the dendritic form of the primary α phase was found to be unaltered by changes in the growth conditions, the form of the primary Si phase was not unaffected by these changes. The usual complex idiomorphic form of the Si phase was transformed to the dendritic form when growth occurred in a supersaturated liquid. Eutectic Si plates, which have been observed to grow from primary Si particles, dominate the eutectic transformation and, by branching, restrict the growth of the eutectic α phase. This mode of solidification produces fine eutectic colonies in this abnormal eutectic structure.

Naval Gun Factory, Washington, D. C.
MAGNETIC PROPERTIES OF NINE COMMERCIAL TITANIUM ALLOYS, by George W. Trickett. 3 June 57, 11p. Technical rept. no. NGF-T-25-57; NAVORD rept. no. 5515.
Order from LC mi$2.40, ph$3.30 PB 139 179

Nine forged and annealed commercial titanium alloys were tested for permeability and retentivity. The estimated permeability of all nine alloys is less than 1.0005 and magnetic retentivity is negligible. A comparison of magnetic properties was made between the tested titanium alloys and other non-magnetic alloys.

## NUCLEAR PHYSICS AND NUCLEAR CHEMISTRY

Air Force Missile Development Center, Holloman AFB, N. Mex.
ESTIMATE OF THE SPECIFIC IONIZATION CAUSED BY HEAVY COSMIC RAY PRIMARIES IN TISSUE OR WATER, by T. Foelsche. Apr 59, 24p. 6 refs. AFMDC-TN-59-7; AD-212 421.
Order from LC mi$2.70, ph$4.80 PB 142 499

The specific ionization caused by the primary particles of carbon, neon, iron, and niobium along their paths in water is calculated by use of the formulae of Bohr, Bethe and Bloch, for the average stopping power. The maximum specific ionization and shape and also half width of the maximum on the end of the path of the particles is estimated according to the considerations about capture and loss of electrons made by Bohr, Brunings, Knipp and Teller, and Bell.

Materials Lab., Wright-Air Development Center, Wright-Patterson AFB, Ohio.
INVESTIGATION OF A NEW DYE-GLASS GAMMA RADIATION DOSIMETER, by Denver Hale. Rept. for May 57-Jan 58 on Materials Analysis and Evaluation Techniques. May 59, 14p. 15 refs. WADC Technical note 59-79; AD-214 763.
Order from OTS $0.50 PB 151 964

The effects of gamma radiation on Methylene Blue, Fluorescein, Rhodamine B, Fast Red S, and Brilliant Green dyes absorbed in Corning "thirsty glass" (code 7930) are presented. The optical absorbancy follows Beer's law with radiation dose to $10^9$ erg $gm^{-1}$ "carbon". The absorption of dyes in this porous glass merits consideration as a gamma ray dosimeter.

California U., Los Angeles.
[NUCLEAR PHYSICS], by Byron T. Wright. Final rept. for 2 Sep 47-30 Mar 56 on Contract N6onr-275, T.O. 4. Apr 58, 10p. 29 refs.
Order from LC mi$1.80, ph$1.80 PB 142 574

A very brief summarization of activities to date. A section is devoted to listing publications and technical reports covering contracted work to date.

Rochester U., N. Y.
RADIOLYSIS OF $CH_3COOCH_3$ AND $CH_3COOCD_3$ BY COBALT-60 GAMMA-RAYS, by P. Ausloos and C. N. Trumbore. Rept. on Contract AF 18(600)1528. 2 Dec 58, 23p. 9 refs. AFOSR TN-58-1067; AD-207 227.
Order from LC mi$2.70, ph$4.80 PB 142 568

Stanford Research Inst., Menlo Park, Calif.
OBTAINING A SYSTEM OF DOSIMETRY, by S. L. Taimuty. Rept. no. 14 (Final) for 28 Sep 56-31 Mar 59 on Contract DA 19-129-qm-766. 16 Mar 59, 105p. 70 refs. QFCIAF File no. S-559.
Order from LC mi$5.70, ph$16.80 PB 142 511

18 integrating dosimeters were chosen for experimental evaluation. Included were four aqueous solutions, four luminescent solids, four glasses, two plastics, nitrous oxide gas, cyclohexane (gas evolution), and chlorinated hydrocarbons (acid production). The performances of these dosimeters were rated against the desirable requirements. The pair which in combination exhibited the fewest deficiencies was the cobalt F-0621 glass dosimeter and the ceric sulfate aqueous solution dosimeter. Continuous beam current and beam energy monitors were developed for use with electron accelerators. Two energy monitoring techniques were developed to suit differing circumstances.

Washington U., St. Louis, Mo.
COSMIC RAYS PHYSICS. Final rept. for 1 Nov 46 - 31 Mar 57 on Contract N6onr-202, T.o. 3. [1957] 11p. 29 refs.
Order from LC mi$2.40, ph$3.30 PB 142 545

In the ten years of its existence, the project has: (1) advanced our knowledge of the properties of the particles resulting from high-energy nuclear collisions, (2) trained numerous graduate students to be practising physicists, (3) established at Washington University a research facility equipped for a wide range of experiments on the properties of the "elementary" particles, whether produced by the cosmic radiation or by accelerators.

California U., Santa Barbara.
NUCLEAR ABSORPTION CROSS SECTIONS FOR 3.6 BEV NEUTRONS, by Paul H. Barrett. Rept. on Contract AF 49(638)9. 22 Dec 58, 10p. 2 refs. AFOSR-TN-59-15; AD-208 596.
Order from LC mi$1.80, ph$1.80 PB 142 587

The absorption cross section for Pb, Cu, and Al were measured by means of poor geometry transmission measurements. The neutrons were produced by bombarding a 1 in thick polyethylene target with 6.2 Bev protons in the Bevatron. Neutron detection was accomplished by measuring the density of stars in nuclear emulsion. These measurements gave for the absorption cross sections for Pb, Cu, and Al 1930 ± 300 mb, 704 ± 140 mb, 430 ± 56 mb. An absorption mean free path in emulsion of $\lambda = 50 \pm 10$ cm was obtained. The source strength of the neutrons was calculated to be 0.19 neutron/steradian/proton striking the target. By comparing the multiplicity of mesons produced in nuclear interactions by the neutron beam and by protons of known energy the average energy of 3.6 ± 0.7 Bev was obtained for the neutron beam.

Institute of Mathematical Sciences, New York U., N. Y.
DIRAC-LIKE WAVE EQUATIONS FOR PARTICLES OF NON-ZERO REST MASS, AND THEIR QUANTIZATION, by J. S. Lomont and H. E. Moses. Rept. on Contract DA 30-069-ORD-2154. Feb 59, 48p. 7 refs. IMM-NYU 255; AD-212 001.
Order from LC mi$3.30, ph$7.80 PB 142 833

Institute of Research, Lehigh U., Bethlehem, Pa.
MULTIPOLE SINGULARITIES OF CLASSICAL VECTOR AND PSEUDOVECTOR FIELDS, by Peter Havas. Rept. on Contract AF 18(600)1462. 25 May 59, 46p. 15 refs. AFOSR TN-59-479; AD-215 732.
Order from LC mi$3.30, ph$7.80 PB 142 472

The general form of the equations of motion of a particle possessing multipole singularities of a neutral vector or pseudovector meson field has been found by Harish-Chandra under the assumption of a divergenceless current. In a recent paper a more general form of the interaction was proposed, and the equations of motion were found for this case for neutral, charged and charge-symmetric fields. In this paper we establish forms of the multipole moments of arbitrary order compatible with these equations, and also of the moments compatible with the more restrictive interactions proposed by Harish-Chandra, which include those of electrodynamics as a special case; they are established under the assumption that the spin of the particle is of constant magnitude and has only spatial components in the rest system, and for pure $2^n$-pole moments of constant magnitude ("intrinsic moments") or of variable magnitude ("induced moments", acceleration-dependent forces).

Iowa State U., Iowa City.
A NEW DETERMINATION OF THE INTENSITIES OF PRIMARY COSMIC RAY ALPHA PARTICLES AND Li Be, B NUCLEI AT $\lambda = 41.5^{o}$ USING A CERENKOV DETECTOR, by William R. Webber. [1956] 49p. 32 refs. Rept. SUI-56-6.
Order from LC mi$3.30, ph$7.80 PB 139 445

Maryland U., College Park.
$K^-$, $\bar{K}^o$ RELATIVE PARITY FROM THE $K^- - D$ CHARGE EXCHANGE REACTION, by T. B. Day, G. A. Snow and J. Sucher. Rept. on Contracts AF 49(638)24 and AT(40-1)2504. Apr 59, 27p. 13 refs. Physics Dept. Technical rept. no. 132; AFOSR-TN-59-435; AD-214 797.
Order from LC mi$2.70, ph$4.80 PB 142 497

The reaction $K^- + D \rightarrow \bar{K}^o + 2n$ is studied in the hope that limitations on the final states for the two neutrons due to statistics will help differentiate between even and odd relative parity of the $K^-$ and $\bar{K}^o$ mesons. The total cross-section for the reaction is calculated in the impulse approximation, and expressed in terms of the corresponding hydrogen cross-section for both even and odd parity. The calculations are carried out (a) with the use of antisymmetrized plane waves for the two neutrons, and (b) in the closure approximation. The ratio of the odd to even parity cross-sections is about a factor of two in either approximation. The total cross-section for odd parity in the plane wave approximation is found to be about 4 mb at a $K^-$ laboratory momentum of 136 Mev/c.

Maryland U., College Park.
THE V-A FOUR-FERMION INTERACTION AND THE INTERMEDIATE CHARGED VECTOR MESON, by S. Oneda and J. Pati. Rept. on Contract AF 49(638)24. Dec 58, 12p. 15 refs. Physics Dept. Technical rept. no. 126; AFOSR-TN-59-46; AD-209 417.
Order from LC mi$2.40, ph$3.30 PB 142 590

Ohio State U. Research Foundation, Columbus.
COLLISIONAL CROSS SECTIONS, by Edwin N. Lassettre. Final rept. on Contract AF 19(122)642. Jan 58, 8p. AFCRC-TN-58-244; AD-152 592.
Order from LC mi$1.80, ph$1.80 PB 139 267

A brief summary is given of some research results obtained under the present contract and reference is given to Scientific Reports which contain detailed descriptions of the individual researches and contain also other results of the various researches. Personnel involved during research under the contract are listed.

Purdue U., Lafayette, Ind.
MUON CAPTURE IN CERTAIN LIGHT NUCLEI, by A. Fujii and H. Primakoff (Washington U.). Rept. on Contract AF 18(600)1579. [1958] 49p. 20 refs. AFOSR TN-59-28; AD-208 873.
Order from LC mi$3.30, ph$7.80 PB 139 235

Yale U., New Haven, Conn.
NATURAL LINE WIDTH FOR TRANSIENT EXCITATIONS, by G. Breit and M. H. Hull, Jr. Contract AF 19(600)771. 25 Sep 58, 27p. 3 refs. AFOSR TN-

58-906; AD-204 516.
Order from LC mi$2.70, ph$4.80 PB 142 685

The absorption of a photon by a material system with 4 participating levels A B C D is studied with special attention to the case in which the levels are the result of combining excitations of separate systems from $a \rightarrow a'$ and from $b \rightarrow b'$ with the identification of A B C D with (a, b), (a, b'), (a', b), (a', b') respectively.

## Nuclear Engineering and Power

Cyclotron Lab., U. of Illinois, Urbana.
FIELD HARMONICS IN THE CYCLOTRON MAGNET, by James A. McKee. Technical rept. no. 4 on Contract Nonr-1834(05). 15 Mar 58, 12p. 4 refs.
Order from LC mi$2.40, ph$3.30 PB 142 820

The University of Illinois rebuilt cyclotron uses four flat spiral shims to introduce spiral modulation of the magnetic field in order to improve axial stability and permit independent synchronization of the cyclotron frequency with the frequency of the fixed radio frequency oscillator. The amplitudes of the various harmonics in the field are of interest in determining the focusing and defocusing effects on the particles. It is desirable that the first harmonic shall not be of order greater than one part in $10^4$ in order to keep the radial oscillation amplitudes small.

Cyclotron Lab., U. of Illinois, Urbana.
MAGNETIC FIELD PROGRAM, by James B. Carroll and James A. McKee. Technical rept. no. 5 (Status) on Contract Nonr-1834(05). Mar 58, 7p. 2 refs.
Order from LC mi$1.80, ph$1.80 PB 142 821

## Nuclear Reactions

Institute of Theoretical Physics, Stanford U., Calif.
TRIDENTS, $\mu$-PAIRS, AND QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES, by J. D. Bjorken and S. D. Drell. Technical note no. 2 on Contract AF 49(638)388. Jan 59, 28p. 10 refs. AFOSR TN-59-44.
Order from LC mi$2.70, ph$4.80 PB 139 213

Four experiments are proposed and discussed as tests of quantum electrodynamics, as applied to photons, electrons, and p-mesons at distances $< 10^{-13}$ cm.

Pennsylvania U., Philadelphia.
STUDIES IN PHOTONUCLEAR REACTIONS. Annual rept. on Contract AF 18(600)472. 15 Oct 58, 11p. 18 refs.
Order from LC mi$2.40, ph$3.30 PB 142 718

Brief summaries presented of findings to date plus a list of publication credits involved in the discussion.

[Sarah Mellon Scaife] Radiation Lab., U. of Pittsburgh, Pa.
THEORETICAL STUDY OF THE PRODUCTION OF SECONDARY DISPLACED ATOMS DURING IRRADIATION, by J. R. Townsend. Final rept. on Contract AF 19(604)3459. 17 Apr 59, 10p. 2 refs. AFCRC-TR-59-142; AD-215 067.
Order from LC mi$1.80, ph$1.80 PB 142 730

A final report is given of the progress made toward the goals of the contract during the contract period. Computer programs are available for treating the classical scattering and the average yield function for knock-on atoms with an arbitrary interaction potential. These programs have been successfully checked using the screened coulomb potential. The larger task of calculating the interaction potential has not been completed. The Fermi-Thomas atomic model has been applied to obtain the charge density for three internuclear separations, but the solutions were unsatisfactory as evidenced by the poor normalization of the charge.

Institute of Mathematical Sciences, New York U., N. Y.
LOW ENERGY SCATTERING BY A COMPOUND SYSTEM: POSITRONS ON HYDROGEN, by Larry Spruch and Leonard Rosenberg. Rept. on Contract AF 19(604)4555. Feb 59, 55p. 25 refs. Research rept. no. CX-40; AFCRC-TN-59-259; AD-212 556.
Order from LC mi$3.60, ph$9.30 PB 142 501

The formalism which gives upper and lower bounds on the phase shift for the scattering of a particle from a center of force is shown to have useful applications when the scatterer is a compound system. The problem of low energy positron scattering from atomic hydrogen, with zero total orbital angular momentum, is studied. It is shown that at zero energy the ordinary variational calculation, which ignores second order contributions, provides a bound on the scattering length, from which a bound on the cross section is deduced. For non-zero energies a bound on the phase shift may similarly be obtained, but for a fictitious problem with cut-off potentials. If the energy is sufficiently small (less than 3 ev) the error thus incurred is expected to be negligibly small. Numerical calculations performed at $k = 0$ and $ka_0 = 0.2$ lead to the result that the effects of polarization are large enough to cause the positron to be on the whole attracted to the hydrogen atom.

Pennsylvania U., Philadelphia.
ENERGY AND ANGULAR DISTRIBUTIONS OF PHOTOPROTONS FROM NITROGEN-15, by Jacob L. Rhodes. Technical rept. no. 3 on Contract Nonr-551(17). Feb 58, 118p. 75 refs.
Order from LC mi$6.00, ph$18.30 PB 142 582

Maryland U., College Park.
SUGGESTED PAIR DISTRIBUTION FUNCTION FOR STRONGLY INTERACTING PARTICLES, by Robert Ayres. Rept. on Contract AF 49(638)399. May 59, 25p. 9 refs. Dept. of Physics Technical rept. no. 134; AFOSR TN-59-624; AD-217 688.
Order from LC mi$2.70, ph$4.80 PB 142 741

A simple treatment of the many-body problem is given using standard methods, but especially emphasizing the connection between the two-body distribution functions in momentum space and configuration space. With the results obtained first order energies are reproduced of the hard-sphere, soft-sphere, square-well and Lennard-Jones gases that obey Fermi or Bose statistics.

New York U., N. Y.
FLUORESCENCE AND CONDUCTIVITY PHENOMENA, by Hartmut Kallmann. Quarterly progress rept. no. 4 (Final) for Nov 57-Jan 58 on Contract DA 36-039-sc-73145. Mar 58, 55p. 4 refs.
Order from LC mi$3.60, ph$9.30 PB 142 712

Contents:
The Basic Processes Occurring in the Liquid Scintillator
Effect of Temperature on Infrared De-Excitation
(See also PB 135 754)

## Acoustics

Armed Forces-NRC Committee on Hearing and Bio-Acoustics, St. Louis, Mo.
CHABA ANNUAL REPORT NO. 5, by Hallowell Davis, Donald H. Eldredge, and J. Richardson Usher. Technical rept. no. 15, 1 June 57-31 May 58, on Contract Nonr-1151(01). June 58, 42p. 22 refs.
Order from LC mi$3.30, ph$7.80 PB 142 548

[Heat Transfer Lab.] Mass. Inst. of Tech., Cambridge.
A HOT-WIRE METHOD FOR VISUALIZING INTENSE STATIONARY SOUND WAVES, by R. M. Fand and J. Kaye. Rept. on Contract AF 33(616)3157. [1959] 12p. 1 ref. WADC Technical note 59-74; AD-211 776.
Order from OTS $0.50 PB 151 940

A simple method has been developed for visualizing intense stationary sound waves, using a thin electrically heated wire stretched in the direction of sound propagation. The nodes and antinodes of the sound waves appear as a series of alternate incandescent and dark areas on the wire. Photographs of the hot wire indicate the presence of hitherto unreported thermo-acoustic phenomena.

Army Signal Research and Development Lab., Fort Monmouth, N. J.
SFERICS RANGING TECHNIQUES, by James W. Wood. 15 Dec 58, 21p. 29 refs. USASRDL Technical rept. 1998.
Order from LC mi$2.70, ph$4.80 PB 142 745

Development of a mobile, single-station sferics-locating system is dependent on a feasible ranging technique. Survey of the literature in the field of measurement of the distance to lightning discharges indicates that a mobile single-station sferics locating system is feasible. Approaches to sferics ranging in the literature have been summarized and the following techniques are considered: (1) Correlation of the amplitude of the energy of the electrostatic, induction, and electromagnetic fields, (2) comparison of the power spectrum as a function of range at ELF (below 500 cycles per second), at frequencies high enough to smooth sky-wave nulls and to determine the more pronounced propagation characteristics, (3) comparison of the time-of-arrival of low frequency components in respect to higher-frequency components, (4) analysis of wave form caused by ionospheric reflection delays, and (5) analysis of the received ground wave below 500 cycles. These techniques are worthy of exploration. Approaches (1) and (2) are the most promising techniques for the measurement of range for a single-station sferics system.

Stanford Research Inst., Menlo Park, Calif.
SRI SFERIC MONITORING SYSTEM, by Earl Goddard. Technical rept. 1 on Contract AF 19(604)2409. Mar 59, 97p. AFCRC-TN-59-183; AD-214 947.
Order from LC mi$5.40, ph$15.30 PB 142 596

A sferics monitoring system has been developed and is currently being operated at three arctic sites to study sferic population, the diurnal, seasonal, and auroral effects on VLF propagation, and the locations of sferic sources. The system is an integrated assembly of electronic, photographic, and electromechanical equipment capable of being operated in several different modes to gather the following data: (1) Number of sferics occurring in four 20-db-intensity levels in four 6-hour time blocks; (2) Bearing of individual sferics; (3) Waveform of individual sferics; (4) Time-integrated bearing patterns; and (5) Noise level and signals in the 12-to 30-kc range. A secondary frequency standard at each site is checked against WWV or WWVH daily, and provides a common time reference for the records from all sites. A modified Watson-Watt direction-finder system with a crossed-loop antenna provides instantaneous bearing. Instantaneous sense is achieved by combining the crossed-loop signals with the signal from an omnidirectional antenna. In addition to the sense function, the latter antenna also provides signal energy to a scanning receiver, a multi-threshold-time-block events counter, and a signal waveform channel.

Brown U. Div. of Engineering, Providence, R. I.
ON THE DISCRETE SPECTRUM FOR DIELECTRIC RODS OF ARBITRARY CROSS SECTION, by E. T. Kornhauser. Scientific rept. no. 3 on Research Directed Toward the Study of Radiation of Electromagnetic Waves, Contracts AF 19(604)4561 and Nonr-562(24). Mar 59, 31p. 8 refs. Scientific rept. AF 4561/3; AFCRC-TN-59-146; AD-211 930.
Order from LC mi$3.00, ph$6.30 PB 142 597

The problem of determining the modes of propagation on a dielectric rod is formulated in general terms, and the determination of the possible types of solution is simplified by discussing these solutions in the critical frequency limit. A fundamental difficulty with the E- and H- wave analysis in this limit is resolved by examining the behavior of the known solutions for the circular rod as the frequency approaches the critical value.

Diamond Ordnance Fuze Labs., Washington, D. C.
EXTENDED THEORY OF THIN WIRE LOOP ANTENNA, WITH AND WITHOUT A SPHERICAL FERRITE CORE, by Julius Herman. 30 Apr 58, 46p. 6 refs. TR-600.
Order from LC mi$3.30, ph$7.80 PB 142 848

Theory has been extended to the cases of finite distributed internal impedance, and lumped internal impedances placed anywhere in the loop. Various desirable characteristics that can be designed into the antenna are: traveling wave antenna, wide latitude in "tailoring" of input impedance, optimization of radiation efficiency with a lossy ferrite core, possibility of gain, directionality and broad-banding, and ability to deliver and radiate high power.

Diamond Ordnance Fuze Labs., Washington, D. C.
FORMULAS FOR THE COMPLETE SERIES EXPANSION OF CERTAIN COMBINATIONS OF ZERO-ORDER BESSEL FUNCTIONS OCCURRING IN COAXIAL AND CYLINDRICAL WAVEGUIDE THEORY, by William E. Ryan. 17 Dec 58, 57p. 29 refs. TR-668.
Order from LC mi$3.60, ph$9.30 PB 142 850

Formulas are derived for the complete expansion of certain Bessel function combinations in alternating power series in x, the smaller of the two arguments. The coefficients of these series are functions only of $\rho$, the ratio of the larger to the smaller argument. These Bessel function combinations occur in problems of electromagnetic-wave propagation in regions of cylindrical geometry, such as coaxial and cylindrical waveguides and cavities, as well as in other branches of physics. In most physical problems, these series converge rapidly so that only the first several terms are needed for a close approximation of the Bessel function combinations. These substitutions greatly simplify the solution of many transcendental equations. From these formulas for the expansion of Bessel function combinations, formulas for combinations of Hankel functions are also obtained.

Linfield Research Inst., McMinnville, Oreg.
RESEARCH ON FIELD EMISSION CATHODES, by E. E. Martin, H. W. Pitman and F. M. Charbonnier. Rept. for 12 Sep 57-9 Nov 58 on Research on Particle Physics of Electronic Components, Contract AF 33(616)5404; continuation of Contract AF 33(616)3851. May 59, 73p. 33 refs. WADC Technical rept. 59-97; AD-210 565.
Order from OTS $2.00 PB 151 960

Design data are presented which simplify prediction of the electrical performance of field emission cathodes from a knowledge of cathode geometry, work function, and position relative to the tube anode. Through use of thoroughly degassed refractory metal electrodes, secondary electron trapping, envelopes of alumino-silicate glass or alumina ceramic, and good vacuum practice, environmental conditions have been reproducibly attained which have permitted long periods of operation of cold tungsten field emitters. The factors affecting the efficiency of tetrode field emission tubes have been analyzed, and the use of such a tube in a voltage regulator circuit tested. Improved control of the geometry of field emitters shaped by electrochemical means has been achieved, and the uniform electrolytic removal of tungsten found useful in fabrication of several complex electrode configurations from tungsten.

Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y.
THE LONG RISE TIMES ASSOCIATED WITH GASEOUS DETECTION OF MICROWAVES, by H. Farber and M. Mentzoni. Rept. on Contract AF 19(604)4143. 24 Feb 59, 19p. 10 refs. Research rept. R-715-59; PIB-643; AFCRC TN-59-175; AD-214 390.
Order from LC mi$2.40, ph$3.30 PB 142 465

During the investigation of microwave detection by glow discharges, transients of very long duration were sometimes found. These can have their origin in neither the ionic transit time nor the circuit. Metastable atoms are therefore thought created and secondary emission from these will account for the large time constants involved. A solution of the diffusion equation in three dimensions for non-steady state and Dirichlet boundary conditions is found for a cylindrical container. The particles that diffuse are the metastable atoms, and their initial distribution is assumed known. An integral equation giving the current due to metastable secondary effects at the electrodes is then solved. Subsequently, a numerical computation is carried out, and corresponding curves are plotted. A comparison between these and those experimentally found shows substantial similarity.

Naval Research Lab., Washington, D. C.
RECENT RESULTS IN PLASMA PHYSICS RESEARCH, by A. C. Kolb and W. R. Faust. Aug 59, 25p. 2 refs. NRL rept. 5391.
Order from OTS $0.75 PB 151 934

The results of recent experimental work with the 285,000 joule condenser bank are described. It is shown that a stable plasma has been obtained and confined for times longer than that required to reach the maximum current. Experimental data on the duration of the neutron pulse agrees with theoretical calcula-

tions of plasma confinement time. If particle densities obtained from measurements of optical bremsstrahlung are used in the calculations, the neutron yield can be accounted for by an ion temperature of about 2 Kev which is consistent with a pressure balance carried out at the final compression.

Rensselaer Polytechnic Inst., Troy, N. Y.
HARMONIC AND SUBHARMONIC RESPONSE OF AN ON-OFF CONTROL SYSTEM TO SINUOIDAL INPUTS, by B. A. Fleishman. Rept. on Contract AF 49(638)514. 7 May 59, 31p. 3 refs. RPI MathRep no. 24; AFOSR-TN-59-360; AD-213 670
Order from LC mi$3.00, ph$6.30 PB 142 841

We derive here periodic solutions, of harmonic and subharmonic type, of a differential equation governing the operation of a relay servomechanism which is subjected to a sinusoidal input $y_0 \sin \omega t$. Each solution is a "formal" solution in the sense that it is constructed under an a priori assumption about the manner in which it changes sign, and this assumption can be verified only after one has the solution. A significant part of the analysis, then, is devoted to the determination of suitable conditions on the parameters $y_0$ and $\omega$ which insure the validity of the formal solution.

Tung-Sol Electric, Inc., Bloomfield, N. J.
RESEARCH AND DEVELOPMENT IN UTILIZATION OF SELF-SUSTAINED ELECTRON EMISSION INVESTIGATION, by B. G. Firth. Progress rept. no. 9 (Final) for 1 July 56-30 Sep on Contract DA 36-039-sc-73051. [1958] 40p. 2 refs.
Order from LC mi$3.00, ph$6.30 PB 142 714

Progress is reported for work on the following phases: MgO cathode electron velocity distribution and surface potential; electroluminescent starter; filamentary starter; audio output amplifier tubes; electrical measurements; and cathode development and tube processing.

Willow Run Labs., U. of Michigan, Ann Arbor.
MICROWAVE PROPAGATION OVER FLAT TERRAIN AT SMALL GRAZING ANGLES, by Robert Fischl and William H. Lawrence. Memo. on Proj. Michigan, Contract DA 36-039-sc-78801. June 59, 32p. 2 refs. Rept. no. 2900-25-R.
Order from LC mi$3.00, ph$6.30 PB 142 783

In order to determine the attenuation of microwaves in the L-, S-, and X-bands, at small grazing angles over flat rural terrain, field strength recordings were obtained for 31 sites within the radio horizon (a 10-mile radius). The measurements were made at wavelengths of 23.2 cm (L-band), 11 cm (S-band), and 3.2 cm (X-band), using horizontal polarization. Pulse modulated transmitters were used. The median attenuation was evaluated for each of the test sites, at the respective wavelengths. The attenuation at X-band was on the average 15 db greater than that at L-band, whereas the attenuation at S-band was only 3 db greater than that at L-band. A range trend of 20 to 30 db per decade is indicated by the regression lines of the medians. The range correlation coefficients show that approximately 25% of the observed variation is due to range; the remainder is attributed to the heterogeneous quality of the terrain.

## Molecular Physics and Spectroscopy

Aeronutronic Systems, Inc., Glendale, Calif.
USEFUL REPRESENTATIONS FOR LABORATORY BAND ABSORPTION MEASUREMENTS, by Gilbert N. Plass. Scientific rept. no. 4 on Contract AF 19(604)2166. 27 Mar 59, 33p. 5 refs. ASI pub. no. U-401; AFCRC-TN-59-269; AD-213 624.
Order from LC mi$3.00, ph$6.30 PB 142 379

Three different methods for the representation of laboratory data on band absorption are discussed. Each method is valid over a considerable range of pressure and amount of absorbing gas; together they accurately represent the absorption for virtually all values of these variables by means of reasonably simple mathematical expressions. Since these approximations have a valid theoretical basis, they can be used to obtain reliable values of the absorption for pressues and amounts of absorbing gas outside of the original experimental range. The three methods are: (1) strong line approximation; (2) weak line approximation; (3) non-overlapping approximation. Methods (1) and (2) are valid regardless of whether or not the spectral lines overlap. Method (3) is valid regardless of whether or not the absorption is weak or strong at the line centers. The regions of validity of each of these approximations are given for the Elsasser and statistical models. An analysis is made of the published data on the absorption of the 9.6 $\mu$ band of ozone by these methods.

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COMPRESSIBILITY OF METHANE AND INTERMOLECULAR FORCES IN METHANE, by H. W. Schamp, Jr., E. A. Mason and others. Rept. on Contract Nonr-595(02). 31 Mar 58, 35p. 28 refs.
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The compressibility of a sample of very pure methane has been measured from 0°C to 150°C and over a pressure range of about 20 to 230 atmospheres.

Laboratory of Molecular Structure and Spectra, U. of Chicago, Ill.
SPECIAL TOPICS IN THE QUANTUM THEORY OF MOLECULAR ELECTRONIC STRUCTURE, by Robert G. Parr. Rept. of a series of lectures given June-July 57 on Contract Nonr-2121(01). 1957, 48p. 93 refs. AD-153 461.
Order from LC mi$3.30, ph$7.80 PB 142 572

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Naval Ordnance Lab., Corona, Calif.
INFRARED ATOMIC SPECTROSCOPY, BASED ON USE OF PHOTOCONDUCTIVE DETECTORS, by Curtis J. Humphreys. May 54, 43p. 55 refs. NOLC rept. 146.
Order from OTS $1.25 PB 151 953

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Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by R. H. Dicke. Quarterly rept. no. 1, 15 June-15 Sep 52, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [195] 12p. 2 refs.
Order from LC mi$2.40, ph$3.30 PB 142 739

There are good theoretical reasons for believing that if the atomic collisions which take place in a gas do not affect the internal vibrations of the gas atoms or molecules, the effect of the collisions is one of narrowing the lines rather than broadening and the breadth of the spectral line may be thought of as arising wholly in the doppler effect modified by collisions. The first quarter was spent in developing and testing the component parts of the apparatus.

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Order from LC mi$1.80, ph$1.80 PB 142 738

Detailed calculations on signal and noise powers with various detection schemes have been made. Additional apparatus has been constructed and tested, notably a high-level pulser and a coincidence gating circuit. Preliminary attempts to find the desired resonance were unsuccessful. (See also PB 142 739)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by R. H. Dicke. Quarterly rept. no. 3, 15 Dec 52-15 Apr 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 7p.
Order from LC mi$1.80, ph$1.80 PB 142 728

Additional studies of atomic hydrogen formation and transport were made to permit greater control over the conditions prevailing in the resonant cavity. Difficulties developed in the system of electronics used, and a new system to eliminate them was devised. Equipment connected with the new system has been designed and built. Detailed calculations as to the effect of electron exchange in collisions between hydrogen atoms were made and confirm previous estimates. (See also PB 142 738)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke. Quarterly rept. no. 4, 15 Mar-15 June 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 13p.
Order from LC mi$2.40, ph$3.30 PB 142 737

Additional attempts to detect the hyperfine transition using pulse techniques were unsuccessful. The decision was made to temporarily convert to continuous-wave methods to facilitate the observation of the resonance, and equipment needed was designed and built. Difficulty was experienced and the system was altered to permit the formation of atomic hydrogen inside the cavity itself, by passing the discharge through the gas bottle in the cavity. An intensive search for the transition using a super-heterodyne detection technique was unsuccessful. A bolometer-detection system will next be tried. Barretters for this have been designed and built, as have other needed components. Additional necessary equipment is under construction. (See also PB 142 728)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke. Quarterly rept. no. 5, 15 June-31 Aug 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 9p.
Order from LC mi$1.80, ph$1.80 PB 142 736

Additional equipment needed in connection with a bolometer-detection system was designed, built and tested. A palladium leak has been constructed to provide a source of very pure hydrogen. (See also PB 142 737)

Palmer Physical Lab., Princeton U., N. J
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke and R. H. Romer. Quarterly rept. no. 6, 1 Sep-30 Nov 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 15p.
Order from LC mi$2.40, ph$3.30 PB 142 735

Improved methods of stabilizing the 1420 m.c. oscillator were developed. As gas conditions in the discharge tube and the bottle in the resonant cavity critically affect the observed signal, attempts to improve and control these conditions were made. A method of

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There are good theoretical reasons for believing that if the atomic collisions which take place in a gas do not affect the internal vibrations of the gas atoms or molecules, the effect of the collisions is one of narrowing the lines rather than broadening and the breadth of the spectral line may be thought of as arising wholly in the doppler effect modified by collisions. The first quarter was spent in developing and testing the component parts of the apparatus.

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPEC TRAL LINES, by R. H. Dicke. Quarterly rept. no. 2, 15 Sep-15 Dec 52, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1952] 6p.
Order from LC mi$1.80, ph$1.80 PB 142 738

Detailed calculations on signal and noise powers with various detection schemes have been made. Additional apparatus has been constructed and tested, notably a high-level pulser and a coincidence gating circuit. Preliminary attempts to find the desired resonance were unsuccessful. (See also PB 142 739)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by R. H. Dicke. Quarterly rept. no. 3, 15 Dec 52-15 Apr 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 7p.
Order from LC mi$1.80, ph$1.80 PB 142 728

Additional studies of atomic hydrogen formation and transport were made to permit greater control over the conditions prevailing in the resonant cavity. Difficulties developed in the system of electronics used, and a new system to eliminate them was devised. Equipment connected with the new system has been designed and built. Detailed calculations as to the effect of electron exchange in collisions between hydrogen atoms were made and confirm previous estimates. (See also PB 142 738)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke. Quarterly rept. no. 4, 15 Mar-15 June 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 13p.
Order from LC mi$2.40, ph$3.30 PB 142 737

Additional attempts to detect the hyperfine transition using pulse techniques were unsuccessful. The decision was made to temporarily convert to continuous-wave methods to facilitate the observation of the resonance, and equipment needed was designed and built. Difficulty was experienced and the system was altered to permit the formation of atomic hydrogen inside the cavity itself, by passing the discharge through the gas bottle in the cavity. An intensive search for the transition using a super-heterodyne detection technique was unsuccessful. A bolometer-detection system will next be tried. Barretters for this have been designed and built, as have other needed components. Additional necessary equipment is under construction. (See also PB 142 728)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke. Quarterly rept. no. 5, 15 June-31 Aug 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 9p.
Order from LC mi$1.80, ph$1.80 PB 142 736

Additional equipment needed in connection with a bolometer-detection system was designed, built and tested. A palladium leak has been constructed to provide a source of very pure hydrogen. (See also PB 142 737)

Palmer Physical Lab., Princeton U., N. J
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke and R. H. Romer. Quarterly rept. no. 6, 1 Sep-30 Nov 53, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1953] 15p.
Order from LC mi$2.40, ph$3.30 PB 142 735

Improved methods of stabilizing the 1420 m.c. oscillator were developed. As gas conditions in the discharge tube and the bottle in the resonant cavity critically affect the observed signal, attempts to improve and control these conditions were made. A method of

studying atomic hydrogen concentrations was developed. Difficulties with several components of the electronics arose. A method of monitoring the r. f. level in the cavity was built. Studies were made of the feasibility of producing atomic hydrogen using the photo-production of excited mercury atoms. Work was begun in this quarter on the problem of producing narrow lines in the ammonia inversion spectrum at 1.25 cm. wavelength. (See also PB 142 736)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke and R. H. Romer. Quarterly rept. no. 7, 1 Dec 53-28 Feb 54, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1954] 15p. 2 refs.
Order from LC mi$2.40, ph$3.30 PB 142 734

A detailed study of the effects of cavity-to-line and bolometer-to-line mismatch has been made, both theoretically and experimentally. Methods of poisoning the walls of the gas-handling system were studied in a "dummy" system, and a low-vapor pressure compound found that would poison the walls without the addition of water vapor to the discharge. Measurement on line shapes as a function of power level and gas pressure were made and compared to theoretical calculations made for various assumptions regarding "relaxation" mechanics. In the work on ammonia at 24,000 m. c., lines approximately 20 kc. wide, compared to the usual Doppler width of 75 kc., have been observed. It is believed that a large part of this width is due to Klystron instability. The design of the large Doppler reducing cavity is discussed. (See also PB 142 735)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATION OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke and R. H. Romer. Quarterly rept. no. 8, 1 Mar-31 May 54, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1954] 18p.
Order from LC mi$2.40, ph$3.30 PB 142 725

Collision reduction of doppler breadth and doppler-reducing cavity. (See also PB 142 734)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATIONS OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke, R. H. Romer, and T. R. Carver. Quarterly rept. no. 11, 1 Dec 54-28 Feb 55, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1955] 35p. 4 refs.
Order from LC mi$3.00, ph$6.30 PB 142 726

Various experimental difficulties associated with the production of sufficient frequency-stabilized microwave power were encountered. Final calculations on the work done with the continuous-wave detection system were made. The pulse detection system has been set up and is described. Preliminary tests to study behavior of the components and to measure power output of the pulsed sidebands have been made. Difficulties associated with the stabilizations of the jammer oscillator when used as a local oscillator with the pulsed system have been encountered. A hydrogen resonance has not yet been observed with the apparatus. A calculation has been made to determine the line shape which might be expected when a large (62 cm. diameter) cavity is used. (See also PB 142 725)

Palmer Physical Lab., Princeton U., N. J.
INVESTIGATIONS OF THE EFFECT OF GAS COLLISIONS UPON THE DOPPLER BREADTH OF SPECTRAL LINES, by J. P. Wittke, R. H. Romer and T. R. Carver. Quarterly rept. no. 12, 1 Mar-31 May 55, on Radio Frequency Transitions between Hyperfine Levels of Atomic Hydrogen, Contract DA 36-039-sc-42539. [1955] 11p.
Order from LC mi$2.40, ph$3.30 PB 142 727

Various measurements of pulsed sideband power were completed. Work has been suspended on the hydrogen resonance in favor of the apparently more feasible rubidium resonance. Work on an optically pumped frequency standard has begun. Rubidium$^{87}$ has been chosen because of certain advantages in all its general properties. Ways of obtaining self-maintained oscillations of such a system have been considered. A stabilized frequency source to study the system and to be used as a local oscillator is the first project. (See also PB 142 726)

Texas U., Austin.
EFFECTS OF HIGH PRESSURE ON THE NEAR ULTRAVIOLET VAPOR ABSORPTION SPECTRUM OF BENZENE IN A NUMBER OF DILUENT GASES, by J. M. Robinson and W. W. Robertson. Rept. on Contract AF 49(638)35. [1959] 32p. 24 refs. AFOSR-TN-59-22; AD-208 752.
Order from LC mi$3.00, ph$6.30 PB 142 838

The absorption spectrum of benzene vapor in a number of gaseous diluents over a wide range of diluent densities has been obtained. The wave length of absorption shifts to the red in the gases A, $H_2$, $N_2$, $CO_2$, $O_2$, CO, $C_2H_6$ and $C_2H_4$, to the blue in the diluents He and Ne. Since the light absorber is the same in each case, the relative rates of shift with density should be a function of the physical properties of the diluents. However, no simple correlation has been found to exist between relative shift and such properties of the solvents as polarizability or dielectric constant. Dispersion theory predicts only roughly the relative shifts. No satisfactory explanation has been found for the blue shift obtained in He and Ne.

## Optics

Air Force Missile Development Center, Holloman AFB, N. Mex.
CALCULATION OF THE CONCENTRATION OF ENERGY AT POINTS OUTSIDE THE FOCAL SPOT OF A PARABOLIC CONDENSER, by Alfred W. Simon.

May 59, 15p. 1 ref. AFMDC-TN-59-11; AD-215 462.
Order from LC mi$2.40, ph$3.30 PB 142 600

An analysis of the distribution of intensity and of energy falling outside of the circular projection of the cone of reflected radiation coming from all infinitesimal areas of the surface of a paraboloidal mirror. The results given in a previous paper under the same title, are incorrect. The correct theoretical deductions and the correct numerical results are given here. A uniform sum is assumed. The original paper which is corrected here appeared as Chapter 7 of "Solar Furnace Support Studies," AFMDC-TR-58-7, Holloman Air Force Base, New Mexico, and on pages 22-24 of Volume II, Number 2, Solar Energy, April 1958.

California U., Berkeley.
A STUDY OF SPACE-CHARGE-WAVE PROPAGATION IN PERIODIC ELECTRON BEAMS, by Armand Staprans. Rept. on Research on Physical Phenomena Affecting the Characteristics of Electron Components, Contract AF 33(616)3278. June 59, 117p. 36 refs. WADC Technical rept. 59-160; AD-212 224.
Order from OTS $2.50 PB 151 961

Propagation of space-charge waves, similarly to field wave propagation on periodic circuits, may be described by modes, each mode containing an infinite number of space harmonics. Expressions for harmonic amplitudes and their propagation constants are derived for infinite as well as for laterally finite beams. Kinetic power flow in the periodic beam modes is analyzed. The coupled-mode analysis of microwave tubes is extended to interactions of periodic beam modes with periodic structures or other periodic beams. An analysis of a folded-line circuit interacting with a periodic beam is carried out to illustrate the application of the theoretical results. An experimental tube using a folded-line slow-wave structure and a periodic electron beam has been built and tested. "A fast-wave" device using interaction between the $TM_{01}$ mode in a circular waveguide and a higher space harmonic of a periodic beam is analyzed. The device is found to be suitable for high-power millimeter-wave generation and amplification.

Centro di Studio per la Fisica Delle Microonde (Italy)
A CLASS OF PERFECT SYSTEMS FOR MICROWAVE OPTICS, by G. Toraldo di Francia and M. Teresa Zoli. Technical note no. 2 on Contract AF 61(052)67. 30 Sep 58, 16p. 3 refs. AFCRC TN-58-573; AD-152 418.
Order from LC mi$2.40, ph$3.30 PB 139 275

A class of perfect optical systems with spherical symmetry are considered, which consist of an outer shell with constant refractive index and a core with variable refractive index. Numerical computations have been carried out for a number of values of the refractive index of the outer shell. It turns out that the total variation of the refractive index within the core becomes very small when the refractive index of the shell has a high value.

Diamond Ordnance Fuze Labs., Washington, D. C.
PERIODIC FOCUSING OF THIN ELECTRON SHEET BEAMS, by William E. Waters. 24 Feb 58, 30p. 6 refs. TR-571.
Order from LC $2.70, $4.80 PB 139 300

This paper is concerned with the properties of three related systems of periodic electrostatic focusing for thin electron sheet beams.

Institute of Mathematical Sciences, New York U., N. Y.
DIFFRACTION BY A SPHEROID, by Bertram R. Levy and Joseph B. Keller. Rept. on Contract AF 19(604)1717. Mar 59, 35p. 8 refs. Research rept. EM-130; AFCRC TN-59-189; AD-215 375.
Order from LC mi$3.00, ph$6.30 PB 142 467

The diffraction of a spherical scalar wave by a hard or soft spheroid is investigated theoretically. The diffracted field is determined by the geometrical theory of diffraction. Then for comparison the corresponding boundary value problem is solved exactly in terms of a series of products of spheroidal functions. The series involves the radial eigenfunctions which correspond to appropriate complex eigenvalues. Asymptotic expansions are derived for these functions for large values of the variable and the parameter. When used in the series solution, these expansions yield the asymptotic form of the diffracted field for incident wavelengths small compared to the spheroid dimensions. This result coincides precisely with that given by the geometrical theory.

New York U., N. Y.
A STUDY OF THE FAR INFRARED PROPERTIES OF CRYSTALS, by J. H. Rohrbaugh. Scientific rept. no. 6, 1 Dec 58-28 Feb 59, on Millimeter Wave Project, Contract AF 19(604)2673. [1959] 20p. 14 refs. AFCRC TN-59-358; AD-216 763.
Order from LC mi$2.40, ph$3.30 PB 142 729

The resonance frequency for NaCl is calculated as a function of temperature; dispersion curves for a particular wave vector are computed at 2°K and compared with values at 300°K and the one dimensional frequency distribution was found at 2°K and compared with that at room temperature. A progress report on the new spectrometer is included also.

## Solid State Physics

Armour Research Foundation, Chicago, Ill.
PURE SILICON CARBIDE IN SINGLE CRYSTAL FORM. LITERATURE SURVEY ON SILICON CARBIDE, by Robert G. Pohl. Final rept. for 1 Sep 56-30 Sep 58 on Contract AF 19(604)1933. Dec 58, 69p. 227 refs. ARF Proj. no. A-092; AFCRC-TR-59-104; AD-208 868.
Order from LC mi$3.90, ph$10.80 PB 139 338

Pyrolytic decomposition of silanes and of silicon tetrachloride and hydrocarbons, in a high temperature vapor phase reaction. Constructional features of an electric high temperature reaction furnace. The growth rate for high purity single crystals of β SiC of preferred crystalline growth habits is quite small, 0.1 mm/hour or less. The best crystals were light yellow and each 1-2 mm long and 0.2 mm in diameter. Electrical measurements on pure and impure single crystals and on aggregates of β SiC indicate an electron mobility $\mu_e - = 32$ cm$^2$/volt-sec, a thermal energy gap $E_{GAP} = 1.90 \pm .10$ ev, and a thermoelectric power $Q = - 105$ μv/deg. A literature survey, with abstracts, of 227 references.

Army Signal [Research and Development Lab] Fort Monmouth, N. J.
THE CADMIUM SULFIDE PHOTOCAPACITOR, by Frederick Gordon, Jr., Phillip A. Newman, Jr., and Jack Handen. 10 Nov 57, 40p. 11 refs. Technical memo. no. M-1934; AD-150 785.
Order from LC mi$3.00, ph$6.30 PB 142 742

The CdZnS photocapacitor is a device that has its effective capacitance changed as a result of a change in the intensity or energy of the radiation incident upon it. The device was found to have sensitivities approaching those of the photomultiplier. The particular approach that seemed most is the effective photodielectric change.

Auburn Research Foundation, Alabama Polytechnic Inst.
STROBOSCOPIC X-RAY DIFFRACTION EXAMINATION OF PIEZOELECTRICALLY OSCILLATING CRYSTALS, by R. Pepinsky. Annual rept. for 1948-1949 on Contract W36-039-sc-38192, continuation of Contract W36-039-sc-32031. 31 Oct 49. 89p. 13 refs.
Order from LC mi$4.80, ph$13.80 PB 142 624

Investigations relating to: (1) detection of structural changes in piezoelectric or ferroelectric crystals, consequent upon applications of mechanical or electrical stresses, and precision measurements of ADP lattice constants.

Bliley Electric Co., Erie, Pa.
SERVICES, FACILITIES AND MATERIALS TO DESIGN AND DEVELOP HIGH SHOCK AND VIBRATION RESISTANT CRYSTAL UNITS, by J. M. Wolfskill and R. H. Tuznik. Quarterly progress rept. no. 3, 1 Oct-31 Dec 57, on Contract DA 36-039-sc-73148. [1958] 19p.
Order from LC mi$2.40, ph$3.30 PB 142 700

A summary of the frequency and resistance data of the first experimental group is included in this report.

Bliley Electric Co., Erie, Pa.
SERVICES, FACILITIES, AND MATERIALS TO DESIGN AND DEVELOP HIGH SHOCK AND VIBRATION RESISTANT CRYSTAL UNITS, by J. M. Wolfskill and R. H. Tuznik. Quarterly progress rept. no. 4,1 Jan-14 Feb 58, on Contract DA 36-039-sc-73148. [1958] 22p.
Order from LC mi$2.70, ph$4.80 PB 142 699

Complete preliminary design specifications were established for each of the frequency-types under consideration by the PR&C 57-ELS/D-3600 program, and units of each type have been constructed. Summaries of frequency and resistance data from the second experimental model group and summaries of aging characteristics of both first and second experimental model types. The various design refinements, including a review of the teflon-glass liner retaining method and the development of epoxy-resin bonding of base to frame are discussed. (See also PB 142 700)

Bliley Electric Co., Erie, Pa.
SERVICES, FACILITIES, AND MATERIALS TO DESIGN AND DEVELOP HIGH SHOCK AND VIBRATION RESISTANT CRYSTAL UNITS, by J. M. Wolfskill and R. H. Tuznik. Quarterly progress rept. no. 5,15 Feb-31 Mar 58, on Contract DA 36-039-sc-73148. [1958] 30p. AD-202 422.
Order from LC mi$2.70, ph$4.80 PB 142 698

This report reviews the aging performances of the various experimental types, discusses the development of the current aging performance levels, and summarizes the data from the third and fourth experimental model type units. (See also PB 142 699)

Bliley Electric Co., Erie, Pa.
SERVICES, FACILITIES, AND MATERIALS TO DESIGN AND DEVELOP HIGH SHOCK AND VIBRATION RESISTANT CRYSTAL UNITS, by J. M. Wolfskill and R. H. Tuznik. Quarterly progress rept. no. 6, 1 Apr-30 June 58, on Contract DA 36-039-sc-73148. [1958] 37p.
Order from LC mi$3.00, ph$6.30 PB 142 697

Elaborate pre-aging was adopted in an attempt to meet the ± 5 PPM/year long term aging rate under "operation" conditions. Performance of the first experimental model units designed for the PR&C 57-ELS/D-3600 phase. Experimental model units were made at five positions covering the 200 - 500 kc range. (See also PB 142 698)

Bliley Electric Co., Erie, Pa.
SERVICES, FACILITIES, AND MATERIALS TO DESIGN AND DEVELOP HIGH SHOCK AND VIBRATION RESISTANT CRYSTAL UNITS, by J. M. Wolfskill and R. H. Tuznik. Quarterly progress rept. no. 7, 1 July-30 Sep 58, on Contract DA 36-039-sc-73148. [1958] 17p.
Order from LC mi$2.40, ph$3.30 PB 142 702

Production of units to complete the required sample quantities. Summaries of aging characteristics, both at room ambient temperature and at +75°C ± 5°C operating temperature, of "3625" program units.

Carnegie Inst. of Tech., Pittsburgh, Pa.
INTERACTION OF CHARGED PARTICLES IN A DIELECTRIC, by Walter Kohn. Technical rept. no. 5 on Contract Nonr-760(13). 28 Mar 58, 29p. 14 refs.
Order from LC mi$2.70, ph$4.80 PB 139 388

This paper is a sequel to an earlier study, from a many-particle standpoint, of the motion of an electron (or hole) in an insulator.

[Clevite Research Center] Cleveland, Ohio.
OPTIMUM METHODS FOR QUARTZ SYNTHESIS, by Danforth R. Hale. Final rept. for 1 Sep 51-28 Feb 54 on Contract DA 36-039-sc-15381. 1954, 58p.
Order from LC mi$3.60, ph$9.30 PB 142 634

In theoretical studies, the phase equilibrium diagram, as it concerns the growing process, was worked out using small autoclaves. The autoclaves were rocked to obtain equilibrium conditions, and quenched in water to maintain the composition of the high-temperature system. The solubility data for silica in 2M sodium carbonate was extended to 400°C and to 10,000 psi. The existence of immiscible fluid phases was confirmed and the significance of the "light" or "less viscous" phase in the quartz growing process was clarified.

[Clevite Research Center] Cleveland, Ohio.
STUDIES OF OPTIMUM METHODS FOR QUARTZ SYNTHESIS, by Danforth R. Hale and Jacob M. Jost. Final rept. for 1 Mar 54-28 Feb 55 on Contract DA 36-039-sc-63114. [1955] 47p. 7 refs.
Order from LC mi$3.30, ph$7.80 PB 142 667

Growing condition with special emphasis on having no "heavy phase" present, yielded high quality quartz. The experiment indicated that the troublesome cementing of residual raw material - one factor that makes clean-out runs desirable - could be avoided. Equipment developed during the Contract includes a hydraulically operated spanner wrench for the 0.21 cu. ft. vertical autoclaves, and a mechanism for operating one of these autoclaves like a torsion pendulum. These are described and pictured.

[Clevite Research Center] Cleveland, Ohio.
STUDIES OF OPTIMUM METHODS FOR QUARTZ SYNTHESIS, by Jacob M. Jost. Quarterly progress rept. no. 1, 1 Mar-31 May 55, on Contract DA 36-039-sc-64589. [1955] 38p. 8 refs.
Order from LC mi$3.00, ph$6.30 PB 142 706

Lower alkali concentrations were investigated in eleven runs. Further study of growth on surfaces of various crystallographic orientations has confirmed the minimum values of growth rates for natural faces, with higher growth rates for other surfaces. Additional solubility work has extended the previously reported phase diagram for the "Hydrothermal Solubility of Quartz in 2M $Na_2CO_3$" into the light liquid phase region.

[Clevite Research Center] Cleveland, Ohio.
STUDIES OF OPTIMUM METHODS FOR QUARTZ SYNTHESIS, by Jacob M. Jost. Quarterly progress rept. no. 2, 1 June-31 Aug 55, on Contract DA 36-039-sc-64589. [1955] 50p. 2 refs.
Order from LC mi$3.30, ph$7.80 PB 142 705

The factors relating to the causes of crevice-flawing and solid inclusions in Y-bar crystals are discussed. The crevice-flawing problem appears to be under control; further work is required on the elimination of solid inclusions. Approximate activation energies of 22,000 and 20,000 cal/mol for the crystallization of quartz on the r- and Z-surfaces, respectively, have been calculated. (See also PB 142 706)

[Clevite Research Center] Cleveland, Ohio.
STUDIES OF OPTIMUM METHODS FOR QUARTZ SYNTHESIS, by Jacob M. Jost. Quarterly progress rept. no. 3, 1 Sep-30 Nov 55, on Contract DA 36-039-sc-64589. [1955] 30p. 10 refs.
Order from LC mi$2.70, ph$4.80 PB 142 707

High quality crystals, except for scattered, small solid inclusions, have again been produced at low temperature, low pressure conditions (300°C, 1500 psi) in a 55.2-liter autoclave with excellent uniformity of growth rate. The solid inclusions usually occurring in synthetic quartz crystals are clumps of small, needle-like acmite crystals. The significance of the ratio of the growth rates in the X- and Z-directions for Y-bar crystals is discussed both as to conditions under which growth occurs and as to the usability of the crystal. (See also PB 142 705)

Clevite Transistor Products, Waltham, Mass.
RESEARCH AND DEVELOPMENT OF GERMANIUM PNP JUNCTION SWITCHING TRANSISTORS, by Paul L. Meretsky. Quarterly progress rept. no. 1, 10 May-9 Sep 58, on Germanium High Current NPN or PNP Junction Switching Transistor, Contract DA 36-039-sc-75060. [1958] 46p.
Order from LC mi$3.30, ph$7.80 PB 142 592

Germanium pnp power transistors in the range of .5°C/watt thermal resistance, $H_{FE}$ current gain of 20 at collector currents of 25 amperes, saturation resistance of 20 milliohms, and rise and fall times of 20 and 30 microseconds, respectively, have been achieved but, not as yet, in a single package. A suitable prototype package has been designed which yields an intrinsic thermal resistance suitable for mounting devices of this type. Strikingly high current gains have been achieved through the use of metallic aluminum introduced in the emitter. It has been found possible to reduce the indium thickness to as little as 7 mils without cracking the 400-mil germanium die.

David Sarnoff Research Center, Princeton, N. J.
GENERATION OF MILLIMETER WAVES IN SOLIDS, by G. C. Dousmanis and R. D. Larrabee. Final rept. for 1 July 56-30 Sep 57 on Contract DA 36-039-sc-73054. 31 Oct 57, 59p. 10 refs. AD-158 073.
Order from LC mi$3.60, ph$9.30 PB 142 713

Of several effects examined for generation of mm waves in solids, the most promising is the one utilizing negative conductivity and negative effective mass carriers in semiconductors. Theoretically, it offers broad-band amplification and generation of radiation up to frequencies of about 500 KMC/sec. The microwave absorption of Ge wafers, activated by high dc fields has been studied. For dc and rf fields parallel or crossed, no rf amplification has been observed, although appreciable decreases in absorption have been

seen. The failure to observe amplification may be due to secondary effects that need further examination.

Diamond Ordnance Fuze Labs., Washington, D. C.
HALL AND RESISTIVITY MEASUREMENTS ON THIN DIFFUSED LAYERS OF GERMANIUM, by Rex J. Snodgrass. 1 May 59, 31p. 6 refs. TR-710.
Order from LC mi$3.00, ph$6.30 PB 142 849

Measurements of conductivity and Hall effect from 77°K to 300°K on n-type germanium samples bulk and thin film, are analyzed and compared. The thin film contains a nonuniform distribution of impurity atoms.

Electronic Components Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
ELECTROLUMINESCENCE: A SELECTED BIBLIOGRAPHY, by Philip K. Trimble. Rept. for 16 Mar-28 Mar 59 on Electroluminescent Phosphor Indicators. Apr 59, 16p. 90 refs. WADC Technical note 59-110; AD-213 601.
Order from OTS $0.50 PB 151 993

This report presents a selection of current bibliographic references on the subject of electroluminescence. The references chosen cover the full range of information on electroluminescence from the theoretical aspects to practical applications. Since the subject is a fairly recent discovery, this bibliography consists entirely of articles from periodicals and reports. A useful feature of this report is the breakdown of the information on electroluminescence into the various subjects or aspects. The subjects are then cross-indexed with the references.

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
INVESTIGATION OF METHODS FOR MEASURING THE EQUIVALENT ELECTRICAL PARAMETERS OF QUARTZ CRYSTALS, by Samuel N. Witt, Jr. and Vance Keith Woodcox. Progress rept. no. 1, 15 Oct 57-15 Jan 58, on Contract DA 36-039-sc-74948. [1958] 51p.
Order from LC mi$3.60, ph$9.30 PB 142 629

Efforts to improve the calibration accuracy of the Crystal Measurement Standard were continued. A crystal power measurement system was designed and built for use with the Crystal Measurements Standard. Accuracies better than ±20 percent were obtained for a VSWR of less than 5 and for power levels between 0.05 and 3 mw.

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
INVESTIGATION OF METHODS FOR MEASURING THE EQUIVALENT ELECTRICAL PARAMETERS OF QUARTZ CRYSTALS, by Samuel N. Witt, Jr. and Vance Keith Woodcox. Progress rept. no. 2, 15 Jan-15 Apr 58, on Contract DA 36-039-sc-74948. [1958] 50p.
Order from LC mi$3.30, ph$7.80 PB 142 628

Shielding of the Eddystone UHF Receiver for use as a null detector was further improved to a point where leakage was negligible. The accuracy of the crystal power measurement system was further improved. (See also PB 142 629)

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.
INVESTIGATION OF THE METHODS FOR MEASURING THE EQUIVALENT ELECTRICAL PARAMETERS OF QUARTZ CRYSTALS, by Samuel N. Witt, Jr. and Vance Keith Woodcox. Progress rept. no. 3, 15 Apr-15 July 58, on Contract DA 36-039-sc-74948. [1958] 46p.
Order from LC mi$3.30, ph$7.80 PB 142 627

Experimental data on several VHF quartz crystals were obtained using the Crystal Measurements Standard System. (See also PB 142 628)

Harvard U., Cambridge, Mass.
SILOXANES AND SANDWICH COMPOUNDS: NUCLEAR MAGNETIC RESONANCE ABSORPTION STUDIES OF MOLECULAR MOTION IN THE SOLID STATE, by Norman Welicky. Technical rept. on Contract Nonr-1866(13). May 58, 39p. 22 refs.
Order from LC mi$3.00, ph$6.30 PB 142 559

This report is composed of two parts. The first deals with nuclear magnetic resonance absorption spectra of some solid Group IV oxides and sulfides, and the second with nuclear magnetic absorption spectra of certain sandwich compounds of iron and chromium.

Hebrew U. (Israel).
THE OPTICAL SPECTRUM OF $Co^{2+}$ IN THE CUBIC CRYSTALLINE FIELD OF $CaF_2$, by R. Stahl-Brada and W. Low. Technical note no. 4 on Contract AF 61(052)59. July 58, 25p. 15 refs. AFOSR-TN-58-1036; AD-206 485.
Order from LC mi$2.70, ph$4.80 PB 139 343

The spectrum is interpreted to arise from transitions from the orbital singlet to various Stark levels split by spin-orbit interaction.

Institute of Tech., U. of Minnesota, Minneapolis.
STUDY OF NOISE IN SEMICONDUCTORS AND SEMICONDUCTOR DEVICES, by A. van der Ziel. Quarterly rept. no. 2, 1 Sep-1 Dec 58, on Contract DA 36-039-sc-78009. [1958] 42p. 8 refs.
Order from LC mi$3.30, ph$7.80 PB 142 765

Deals with noise measurements in bulk semiconductors at 80°K and 4.2°K, with avalanche breakdown in junctions, and verifies a theoretical prediction concerning transistor noise.

Laboratory for Insulation Research, Mass. Inst. of Tech., Cambridge.
TABLES OF DIELECTRIC MATERIALS, VOLUME VI. Rept. on Contract Nonr-1841(10). June 58, 115p. Technical rept. 126.
Order from LC mi$6.00, ph$18.30 PB 142 549

Volume VI is the final volume; it supplements Volumes IV and V and includes new materials and extended data on some of the materials listed in previous Tables. Frequency runs at room temperature are given in graphical instead of the tabular form used in Volumes III to V. The index covers Volumes IV to VI. No new data on ferroelectric materials are presently available.

Maryland U., College Park.
A REMARK ON THE MEISSNER EFFECT AND THE THEORY OF PERFECTLY FREE ELECTRONS, by Jean Peretti. Rept. on Contract AF 49(638)399. June 59, 4p. 1 ref. Dept. of Physics Technical rept. no. 140; AFOSR-TN-59-554; AD-216 719.
Order from LC mi$1.80, ph$1.80 PB 142 604

Massachusetts Inst. of Tech., Cambridge.
THE USE OF POLARIZED NEUTRONS IN DETERMINING THE MAGNETIC SCATTERING BY IRON AND NICKEL, by R. Nathans, C. G. Shull and others. Technical rept. no. 3 by Structure of Solids Group on Contract AF 18(603)84. 19 Nov 58, 21p. 11 refs. AFOSR TN 59-61; AD-209 324.
Order from LC mi$2.70, ph$4.80 PB 142 541

Procedures for obtaining and using polarized beams of monochromatic neutrons are outlined and experimental data are presented on the performance of two polarizing crystals, $Fe_3O_4$ and 92 Co-8 Fe alloy. The reflectivity of neutrons of different polarization state by single crystals of iron and nickel is used for determining the magnetic scattering amplitudes.

Materials Research Lab., Watertown Arsenal, Mass.
X-RAY AND NEUTRON SCATTERING FROM ELECTRONS IN A CRYSTALLINE FIELD AND THE DETERMINATION OF OUTER ELECTRON CONFIGURATIONS IN Fe AND Ni, by R. J. Weiss and A. J. Freeman. Dec 58, 41p. 8 refs. MRL rept. no. 59; AD-207 849.
Order from LC mi$3.30, ph$7.80 PB 142 528

Michigan U. Coll. of Engineering, Ann Arbor.
LOW-TEMPERATURE HEAT CAPACITIES AND THERMODYNAMIC PROPERTIES OF ZINC FERRITES. III. EFFECT OF COPPER SUBSTITUTION, by D. M. Grimes and Edgar F. Westrum, Jr. Technical rept. no. 6 on Contract AF 18(603)8. Jan 59, 15p. 7 refs. 2495-11-T; AFOSR-TN-58-980; AD-205 877.
Order from LC mi$2.40, ph$3.30 PB 139 339

The heat capacities of annealed and quenched samples of $Cu_{0.05}Zn_{0.90}Fe_{2.05}O_4$ have been determined over the range 5-350°K. The Neel temperature is the same as previously reported for a similar lithium-substituted zinc ferrite. The result is discussed in terms of sublattice population and molecular field coefficients.

Minnesota U. School of Chemistry, Minneapolis.
SOME REMARKS ABOUT CRYSTALLOGRAPHIC CALCULATIONS ON HIGH-SPEED DIGITAL COMPUTERS, by M. G. Rossmann, R. A. Jacobson and others. Rept. on Contract Nonr-710(23). 14 Aug 58, 22p. 24 refs. AD-202 261.
Order from LC mi$2.70, ph$4.80 PB 142 460

An account of a general least-squares program deals with a method of introducing the space group symmetry into both positional and thermal parameters of each atom. The choice of a damping factor is discussed in relation to convergence. An example is given of how the least-squares method was able to show up two incorrectly-placed atoms in an otherwise correct structure. A one-letter code which represents electron density is described as a way of overcoming the output difficulty for a general Fourier summation program.

Moore School of Electrical Engineering, U. of Pennsylvania, Philadelphia.
MICROWAVE CRYSTAL DETERIORATION STUDIES, by P. P. Lombardini. Quarterly progress rept. no. 1, 1 Aug-31 Oct 58, on Contract DA 36-039-sc-78055. 30 Nov 58, 24p. 1 ref.
Order from LC mi$2.70, ph$4.80 PB 142 764

After outlining the problems connected with the mechanism of crystal deterioration the work reported is concerned with the process of temporary deterioration. The results of the investigations have shown, for all samples tested, that an increase in the backward slope of the crystal characteristic occurs concurrently with a decrease in the rectification efficiency of an X-band CW signal. Although no direct relationship exists between the change in the backward characteristic and the rectified current, it is shown by an analysis of a high frequency equivalent circuit of the crystal mixer that the relationship is complicated by the parameters inherent in the structure of the mixer.

Naval Research Lab., Washington, D. C.
DIPOLE FIELDS AND NORMAL MODES IN MAGNETIC GARNET, by J. I. Kaplan. Final rept. 31 July 59, 9p. 12 refs. NRL rept. 5356.
Order from LC mi$1.80, ph$1,80 PB 140 820

On the basis of a calculation of the classical dipole fields in garnet it is shown that the d sites, from the point of view of dipole anisotropy, should be divided into three sublattices. The resonance frequency and susceptibility for the mode in which the spins of the d sublattices move in opposition to each other is calculated. For Gd iron garnet $X \cong 10^{-3}$ near the compensation point. The dipole fields at the Yt sites in Yt iron garnet were also calculated. These fields should provide the Yt nuclear magnetic resonance frequencies assuming hyperfine contact with the magnetic sites is weak. Arguments are given to support this contention.

Ohio State U. Research Foundation, Columbus.
STATISTICAL THEORY OF LATTICE DISTORTION -- ITS EFFECT ON ORDERING, by Tunemaru Usui. Technical note no. 1 on Contract AF 49(638)264. June 58, 15p. 2 refs. AFOSR TN-58-995; AD-205 903.
Order from LC mi$2.40, ph$3.30 PB 139 430

The effect of difference in atomic "size" between two components of a simple binary solid solution on the ordering is investigated by assuming a lattice distortion

of the type expected in an elastic medium. It is found that the critical temperature is always lowered compared to the case without distortion and that the degree of range order at the critical temperature also decreases.

Purdue Research Foundation, Lafayette, Ind.
SILICON CRYSTAL PERFECTION STUDY, by H. J. Yearian. Quarterly progress rept. no. 1, 1 June-31 Aug 58, on Contract DA 36-039-sc-77991. [1958] 28p. 11 refs.
Order from LC mi$2.70, ph$4.80 PB 142 623

Single crystals of Si have been grown on the 111 axis by the Czochralski method using a carbon resistance furnace and a quartz crucible in purified He. The resistivities ranged from 4 to 370 ohm cm and lifetimes from 20 to 80 μ sec. Using a very small seed of high perfection indicated that with sufficient control of growth conditions it was possible to grow a dislocation free crystal of considerable size.

Purdue Research Foundation, Lafayette, Ind.
SILICON CRYSTAL PERFECTION STUDY, by H. J. Yearian. Quarterly progress rept. no. 2, 1 Sep-30 Nov 58, on Contract DA 36-039-sc-77991. [1958] 23p. 9 refs.
Order from LC mi$2.70, ph$4.80 PB 142 703

Undoped and B doped crystals of good quality have been pulled from a crucible with a small seed of high perfection. Preliminary experiments on crucible-less small seed growing have been made. The etching method of revealing dislocations was compared with decoration and X-ray topograph methods. It was found that the precipitation of Cu or Pt on dislocations took place very rapidly at 900°C. (See also PB 142 623)

Radio Corp. of America, Camden, N. J.
INVESTIGATION OF MECHANICAL OVERTONE CRYSTALS, 50 MC TO 150 MC OR HIGHER, by E. M. Washburn. Quarterly progress rept. no. 3, 15 Oct 49-15 Jan 50, on Contract W36-039-sc-38265. [1950] 69p.
Order from LC mi$3.90, ph$10.80 PB 142 643

The crystal units recommended for this frequency range employ the standard HC-6 type holder, with its two looped spring wires. The oscillator quartz plate is polished, unplated and mounted between thin quartz discs which are plated centrally on a recessed area to form suitably sized electrodes and airgaps. These crystals are lapped and polished in soldered-ring stretched carriers .0015" thick to produce a crystal thickness slightly over .002". This report describes unsuccessful attempts to produce units of equal or better quality by optical lapping techniques.

Radio Corp. of America, Camden, N. J.
INVESTIGATION OF MECHANICAL OVERTONE CRYSTALS, 50 MC TO 150 MC OR HIGHER, by E. M. Washburn. Quarterly progress rept. no. 4, 15 Jan-15 Apr 50, on Contract W36-039-sc-38265. 1950, 78p.
Order from LC mi$4.50, ph$12.30 PB 142 642

Many groups of overtone quartz plates have been fabricated to operate at their 3rd, 5th, 7th, 9th and 11th overtones, to cover the range from 50 MC to 150 MC per second. This report describes improvements in the electrode design and in the electrode fabrication and plating processes. (See also PB 142 643)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 1, 15 Jan-14 Apr 51, on Contract DA 36-039-sc-5460. [1951] 36p.
Order from LC mi$3.00, ph$6.30 PB 142 660

A new 2-point holder has been designed, which makes contact with the quartz plate only at diametrically opposite points, along the Z' axis. The new design does facilitate quartz plate assembly and cementing. Its cost is appreciably lower than the 3-point holders and it is not polarized.

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 2, 15 Apr-14 July 51, on Contract DA 36-039-sc-5460. [1951] 37p.
Order from LC mi$3.00, ph$6.30 PB 142 661

Comparison of many frequency-temperature runs versus verified quartz plate orientation showed that the correct Z-Z' Angle for minimum frequency deviation is $+34^{\circ}54' \pm 3'$. The recommended manufacturing process, particularly for units between 900 KC and 1000 KC, has been simplified by omitting the 24 hour high temperature-slow cooling annealing cycle, and by combining three plating operations into one. (See also PB 142 660)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 3, 15 July-14 Oct 51, on Contract DA 36-309-sc-5460. [1951] 38p.
Order from LC mi$3.00, ph$6.30 PB 142 662

Improved adhesion is obtained by using clean, unplated brackets. Aging tests conducted on ten 1000 KC units for a period of nearly three months at 75°C, show a uniform trend to increase frequency and decrease resistance. The orientation tolerances have been opened on both the X-X' and Z-Z' angles. The former is now $0^{\circ} \pm 30'$ and the latter, for 1000 KC, is $+35^{\circ}55' \pm 5'$. The two cemented joints between crystal and supporting brackets are made with Liquid Araldite Adhesive #15 in place of the stick Araldite formerly used. Both of these changes are important to reduce manufacturing costs without any danger of impairing the crystal unit quality. (See also PB 142 661)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW

FREQUENCY CONTOURED AT-CUT QUARTS PLATES, by E. M. Washburn. Quarterly progress rept. no. 4, 15 Oct 51-14 Jan 52, on Contract DA 36-039-sc-5460. [1952] 36p.
Order from LC mi$3.00, ph$6.30 PB 142 663

Comparative vibration and drop tests between the standard semi-rigid 2-point holder and a new flexible wire design shows that the former is slightly superior. Minor refinements have been made in the fabrication processes for 1000 KC CR-18 units. Adjustment of CR-27 or CR-28 units to exact frequency was readily accomplished by heating the individual crystals to the operating temperature in the plating chamber. (See also PB 142 662)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 5, 15 Jan-14 Apr 52, on Contract DA 36-039-sc-5460. [1952] 31p.
Order from LC mi$3.00, ph$6.30 PB 142 664

A study was made to determine permissible contour variations for the central 5/16" diameter areas. A new method of evaporation plating forms both electrodes and adjusts the unit to exact frequency, all in one operation. Edge grinding of resistance reject units to maximum activity at room temperature, shows a 23% yield. Concentrated attention was given to a revised quartz plate mounting to resist drop tests. (See also PB 142 663)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 6, 15 Apr-14 July 52, on Contract DA 36-039-sc-5460. [1952] 36p.
Order from LC mi$3.00, ph$6.30 PB 142 665

The outstanding development was the design of a 1000 Kc CR-18 crystal unit which not only withstands the vibration test but also 3 random drops through a vertical height of 12 inches onto a 2" thick oak plank. Although these new units show resistances of the same order as the 2-point notched bracket units at 1000 Kc, lower frequency units such as 833 Kc show unexpectedly high resistance. Permanent damage to gold plated electrode occurs at high crystal currents, such as 40 ma. (See also PB 142 664)

Radio Corp. of America, Camden, N. J.
RESEARCH INVESTIGATIONS PERTAINING TO LOW FREQUENCY CONTOURED AT-CUT QUARTZ PLATES, by E. M. Washburn. Quarterly progress rept. no. 7, 15 July-14 Oct 52, on Contract DA 36-039-sc-5460. [1952] 38p.
Order from LC mi$3.00, ph$6.30 PB 142 666

Work includes improvements made in the 2-point Araldite cemented units, and the further development of 4-point teflon mounted units. The three most important factors in improving the quality and yield of the 2-point units were to avoid application of excessive amounts of cement at each joint, to avoid excessive heat at cover soldering, and to emphasize careful handling at all operations after cement curing. Teflon mounted 1000 Kc crystal units have been aged at 80°C for 113 days. (See also PB 142 665)

Shockley Semiconductor Lab., Beckman Instruments, Inc., Mountain View, Calif.
STUDY OF ULTIMATE HIGH FREQUENCY AND HIGH POWER LIMITS OF SEMICONDUCTOR DEVICES, by William Shockley. Final rept. for 1 July 57-15 Oct 58 on Contract DA 36-039-sc-74914. [1958] 75p 4 refs.
Order from LC mi$4.50, ph$12.30 PB 142 591

How known physical properties of silicon such as dielectric constant, carrier mobility, thermal conductivity, and so forth, limit the ultimate high frequency and high power performance of junction transistors and junction tetrodes of conventional form but arbitrary dimensions.

Uppsala U. (Sweden).
THE CRYSTAL STRUCTURE OF $Ni_{12}B_5$, by Stig Rundqvist and Egon Larsson. Technical note no. 4 on Contract AF 61(052)40. 22 Nov 58, 13p. 11 refs. AFOSR-TN-59-35; AD-209 207.
Order from LC mi$2.40, ph$3.30 PB 142 586

The crystal structure of $Ni_{12}P_5$ has been determined with single-crystal methods. The unit cell, containing 2 formula units, is tetragonal, $a = 8.646$ Å; $c = 5.070$ Å. A comparison of $Ni_{12}P_5$ with related structures is made. Some phase-analytical observations in the Ni-P system are reported. $NiP_3$ is cubic, $a = 7.819$ Å; and isostructural with $CoP_3$, $a = 7.706$ Å. Both $NiP_3$ and $CoP_3$ belong to the D2 ($CoAs_3$) structure type.

Uppsala U. (Sweden).
THE CRYSTAL STRUCTURE OF $Ru_7B_3$, by Bertil Aronsson. Technical note no. 1 on Research on Metallic Phases in Systems of Transition Metals with Non-Metals, Contract AF 61(052)40. [1958] 12p. 14 refs. AFOSR-TN-58-1090; AD-207 587.
Order from LC mi$2.40, ph$3.30 PB 142 588

The crystal structure of $Ru_7B_3$ has two formula units in the unit cell, determined to be hexagonal with $a = 7.467$ Å and $c = 4.713$ Å. The structure is very closely related to that of the trigonal chromium carbide $Cr_7C_3$.

Uppsala U. (Sweden).
STRUCTURES OF $Ni_6Si_2B$, $Fe_2B$ AND SOME RELATED PHASES, by Stig Rundqvist and Franz Jellinek. Technical note no. 2 on Contract AF 61(052)40. 20 Oct 58, 14p. 25 refs. AFOSR-TN-58-1019; AD-162 284.
Order from LC mi$2.40, ph$3.30 PB 139 341

The $Fe_2P$ (C 22) structure symmetry is hexagonal, rather than trigonal. The phases $Ni_6Si_2B$, $Mn_2P$, and $Ni_2P$ are isotypic with $Fe_2P$, but $Co_2P$ possesses a different - orthorhombic - structure.

Uppsala U. (Sweden).
X-RAY INVESTIGATIONS ON Me-Si-B SYSTEMS (Me = Mn, Fe-Co) I. SOME FEATURES OF THE Co-Si-B SYSTEMS AT 1000 °C. INTERMEDIATE PHASES IN THE Co-Si-B AND Fe-Si-B SYSTEMS, by Bertil Aronsson and Gunvor Lundgren. Technical note no. 3 on Contract AF 61(052)40. 20 Oct 58, 18p. 23 refs. AFOSR-TN-58-1020; AD-162 285.
Order from LC mi$2.40, ph$3.30 PB 139 342

The crystal structure of $Co_{4.7}Si_2B$ (isomorphous with $Fe_{\sim 4.7}Si_2B$) has been established from single crystal data and is closely related to the $W_5Si_3$(T1) structure. The crystal structures of $Fe_5SiB_2$ and $Mn_5SiB_2$ are shown to be of the $Cr_5B_3$(T2) type.

Willow Run Labs., U. of Michigan, Ann Arbor.
SUM RULES AND RELATIVE INTENSITIES FOR PARAMAGNETIC IONS OF SPIN 3/2, by Chihiro Kikuchi. Memo. on Proj. Michigan, Contracts DA 36-039-sc-78801 and AF 49(638)68. June 59, 18p. 6 refs. Rept. no. 2900-65-R.
Order from LC mi$2.40, ph$3.30 PB 142 751

Certain sum rules for cross-checking numerical calculations needed in the design of masers are derived, and the results obtained by using these sum rules are compared with the values calculated by machines. In addition, it is shown that the intensities for complementary transitions are equal when the r-f field is parallel to the d-c magnetic field.

## Thermodynamics

Bureau of Mines, Bartlesville, Okla.
THE PRESSURE-VOLUME-TEMPERATURE PROPERTIES OF PERFLUOROCYCLOBUTANE: EQUATIONS OF STATE, VIRIAL COEFFICIENTS, AND INTERMOLECULAR POTENTIAL ENERGY FUNCTIONS, by D. R. Douslin, R. T. Moore, and Guy Waddington. Technical note on Contract CSO 680-57-4. May 59, 31p. 20 refs. AFOSR-TN-59-493; AD-215 846.
Order from LC mi$3.00, ph$6.30 PB 142 513

Studies of the pressure-volume-temperature properties of perfluorocyclobutane in the ranges, 3-394 atm., 30-350°, yielded values of gas compressibility, critical constants, vapor pressure and orthobaric liquid and vapor densities. The results were correlated by the Beattie-Bridgeman, Benedict-Webb-Rubin, and Martin-Hou equations of state, and by the Stockmayer and the Kihara intermolecular potential energy functions. The merits of the several correlational methods are discussed.

California Inst. of Tech., Pasadena.
THERMAL CONDUCTIVITY OF FLUIDS. NITROUS OXIDE IN THE GAS PHASE, by G. Neal Richter and B. H. Sage. Rept. on Contract N6ori-105, T. O. 3. July 58, 18p. 12 refs. Proj. Squid Technical rept. no. CIT-3-P; AD-200 655.
Order from LC mi$2.40, ph$3.30 PB 139 067

Data concerning the thermal conductivity of nitrous oxide was taken at temperatures from 40° to 400°F. and at pressures up to 1000 pounds per square inch. It was not possible to obtain satisfactory data near the critical state.

General Electric Co., Cincinnati, Ohio.
NITROGEN AT HIGH TEMPERATURES, by Frank Martinek. Rept. on Contract AF 49(638)243. [1959] 52p. 16 refs. AFOSR-TN-59-264; AD-212 467.
Order from LC mi$3.60, ph$9.30 PB 142 503

Presented at ASME High-Temperature Symposium, Purdue U., Feb 59.

The basic thermodynamic properties of pure nitrogen at high temperatures are presented. Internal energy, enthalpy, entropy, electron density, and electrical conductivity are given in engineering units for the temperature range from 5000 to 30,000°K, and pressures varying from 0.2 to 100 atm. The temperature and pressure dependency of dissociation and ionization is also shown. All calculations are based on statistical thermodynamics.

Heat Transfer Lab., Mass. Inst. of Tech., Cambridge.
THE DESIGN AND CONSTRUCTION OF AN OPTICAL BOUNDARY LAYER PROBE, by Michael M. Chen. Rept. on Cohtract AF 33(616)3157. Dec 58, 63p. 11 refs. WADC Technical note 58-13; AD-210 751.
Order from OTS $1.75 PB 151 870

The use of a probe type instrument, utilizing optical principles similar to schlieren apparatus, and small enough to be inserted in thermal boundary layers, is explored, both theoretically and experimentally. Equations governing the design and operation of such a probe are developed. Theoretical results show the probe to be feasible, though with low precision. An experimental probe failed to operate as expected. The failure is attributed to imperfect optics. An alternate design, which is expected to be less sensitive to surface imperfections of optical elements, is also included.

Heat Transfer Lab., U. of Minnesota, Minneapolis.
PRESSURE DROP AND HEAT TRANSFER IN A DUCT WITH TRIANGULAR CROSS-SECTION, by E. R. G. Eckert and T. F. Irvine, Jr. Rept. on Contract AF 33(616)3853. Apr 59, 61p. 10 refs. WADC Technical rept. 59-222; AD-214 612.
Order from OTS $1.75 PB 151 977

Friction factors have been measured for a duct whose cross-section has the shape of an isosceles triangle with a side ratio 5 to 1 in the fully developed flow region for laminar, transitional and turbulent conditions. In addition, local and average heat transfer coefficients and the temperature field in the duct wall have been determined for the condition of constant heat generation per unit volume of the duct walls. Friction factors in laminar flow agreed well with analytical predictions. In the turbulent flow range they were by

20 per cent lower than values calculated from relations for a round tube with the use of the "hydraulic diameter" Heat transfer coefficients averaged over the circumference of the duct were only half as large as values calculated from round tube relations in the Reynolds number range from 4300 to 24,000. The measurements also revealed that thermal starting lengths were in excess of 100 diameters. In round tubes a length of 10 to 20 diameters has been found sufficient to develop the temperature field.

Illinois U. [Urbana].
THERMAL STRESS PROBLEMS OF SHELLS, by H. L. Langhaar and A. P. Boresi. Technical rept. no. 2 on Contract Nonr-1834(14). Mar 58, 33p. 4 refs. T & AM rept. no. 131.
Order from LC mi$3.00, ph$6.30 PB 139 419

Several thermal stress problems of shells are solved by three-dimensional thermoelasticity theory, and comparisons with the results obtained by shell theory are given.

Institute of Research, Lehigh U., Bethlehem, Pa.
MEASURED HEAT FLOW TO THE WALL OF A SHOCK TUBE, by W. Paul Thompson. Technical rept. no. 10 on Contract N7onr-39302. 1 July 58, 38p. 12 refs.
Order from LC mi$3.00, ph$6.30 PB 142 678

A graphical method of analysis of wall temperature records taken in the 3/8" x 4" shock tube at Lehigh University is presented. The primary aim is the development of a rapid survey method for determining the heat flux to the wall for a range of tube conditions. Shock strengths $P_{21}$ from 1.3 to 5.5, with initial channel pressures $p_1$ from 40 to 3000 mm of mercury, are investigated.

Materials Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio.
TRANSPARENT CONDUCTING COATINGS OF GOLD ON GLASS, by Richard E. Pawel. Rept. for June 57-Jan 58 on Materials Analysis and Evaluation Techniques. May 59, 20p. 11 refs. WADC Technical note 58-302; AD-214 386.
Order from OTS $0.50 PB 151 893

The effect of various substrates on the adhesion of Transparent Conductive Coatings of Gold on Glass was studied. SiO, CuO, CaO, $Sb_2S_3$ PbO, CeO, $Cr_2O_3$, $SnO_2$, Cu-CuO and $MgF_2$ were tried as substrate materials. Both the substrate and the gold were deposited without breaking the vacuum. CuO and $SnO_2$ materially increased the abrasion resistance but still not to the desired level of adherence. Gold films could be produced on these substrates having transmittances of 50 - 75% and resistances from 10 - 150 ohms per square. Films having transmittances above 75% resulted in extremely high resistances, due to physical discontinuities. For applications requiring transmittances above 75% doped oxide films appear more conductive than gold films.

Michigan U. Research Inst., Ann Arbor.
ON THERMO-ELASTIC STRESS-STRAIN RELATIONS FOR THIN ISOTROPIC SHELLS, by P. M. Naghdi. Technical note no. 3 on Contract AF 18(603)47. Oct 58, 5p. 3 refs. 2500-4-T; AFOSR TN-58-994; AD-205 904.
Order from LC mi$1.80, ph$1.80 PB 139 391

Naval Research Lab., U. of Wisconsin, Madison.
THE CONTRIBUTION OF BOUND, METASTABLE, AND FREE MOLECULES TO THE SECOND VIRIAL COEFFICIENT, by Daniel E. Stogryn and Joseph O. Hirschfelder. Rept. on Contract N7onr-28511. 15 Mar 58, 44p. 1 ref. WIS-ONR-32.
Order from LC mi$3.30, ph$7.80 PB 142 569

Stanford U., Calif.
AN INVESTIGATION OF LOSSES OF FLOW STREAM MECHANICAL ENERGY AT ABRUPT CHANGES IN FLOW CROSS SECTION, by W. M. Kays. Technical rept. no. 1 on Contract N6onr-251, T. O. 6. 15 Sep 48, 90p. 7 refs. ATI-119 236.
Order from LC mi$4.80, ph$13.80 PB 142 672

This report contains the results of an investigation of the losses of flow stream mechanical energy at abrupt changes in flow cross-section with the overall objective of developing a method of evaluating these losses for application to the testing of high-rating heat exchanger surfaces. The investigation is concerned with relatively low Reynolds' Number flow ($\lesssim$12,000) in heat exchanger flow passages using an essentially incompressible fluid. Equations are derived for analytically predicting the performance of certain idealized systems, the results of tests to substantiate the analytical relations are presented, and a method is developed to extrapolate the results of limited tests of heat exchanger systems. This work is not to be considered as complete, but it is believed that substantial progress has been made in the understanding of the abrupt contraction and expansion phenomena.

## Wave Propagation

Cornell U. School of Electrical Engineering, Ithaca, N. Y.
A METEOROLOGICAL INTERPRETATION OF WAVELENGTH DEPENDENCE IN TRANSHORIZON PROPAGATION, by Ralph Bolgiano, Jr. Scientific rept. no. 2 on Radio Scattering in the Troposphere, Contract AF 19(604)3494. 15 Sep 58, 106p. 33 refs. Research rept. EE-385; AFCRC TN-58-384; AD-160 796.
Order from LC mi$5.70, ph$16.80 PB 139 400

Since scatter propagation theory has predicted so satisfactorily the broad aspects of the radio signals, it is retained as the basis for further analysis. A new model is developed for the structure of refractive index fluctuations induced by turbulence. Grounded on a theory of homogeneous turbulence in a stably stratified atmosphere, which is propounded here in some detail also, this new model provides an explanation for the observed distribution of wavelength dependence. It

suggests that at times when the dynamic stability of the air within the scattering volume is neutral the received power should be nearly independent of radio wavelength. On the other hand, when the atmosphere is dynamically stable, the signal strength should be proportional to the square, or higher power, of the wavelength.

Diamond Ordnance Fuze Labs., Washington, D. C.
ENERGY DISTRIBUTION AND FIELD CONFIGURATION IN FERRITES, by John E. Tompkins. 30 June 58, 24p. 16 refs. TR-634.
Order from LC mi$2.70, ph$4.80 PB 142 688

Cylindrical waveguides containing coaxially mounted, longitudinally magnetized ferrite rods are important in many devices. The theory is discussed briefly, and expressions for the microwave field components are given. Results are given of exact calculations made on an electronic digital computer concerning propagation characteristics of such guides. Specifically considered are; (a) propagation constants, energy and field distributions for the rod in the guide and for the rod in free space for several values of the ferrite parameters, (b) the ellipticity of polarization of the r-f magnetic field as a function of radius, (c) higher-order propagation modes, and (d) a qualitative picture of the effect of a rectangular waveguide upon the propagation characteristics of a rod.

Electrical Engineering Research Lab., U. of Texas, Austin.
MEASURED ABSORPTION OF MILLIMETER WAVELENGTHS BY OXYGEN AT PARTIAL ATMOSPHERIC PRESSURE, by C. W. Tolbert, J. H. Douglas and C. O. Britt. Rept. on Contract Nonr-375(01). 15 May 58, 14p. 10 refs. Rept. no. 100.
Order from LC mi$2.40, ph$3.30 PB 139 452

A micro-wavelength spectrometer whose measuring cell is a 240 foot length of 6 inch diameter copper tubing and the results of measurements of the oxygen absorption spectrum at 60 kmcs are described in this report. Since the spectrometer, at present, is not instrumented for "mechanically" frequency sweeping the microwave signal source, individual absorption lines could not be adequately resolved to permit line breadth measurements. Measurements were made at discrete intervals of 200 mc per sec. between 54 kmcs and 59 kmcs over a pressure range of 0.5 mm to 760 mm of mercury. The integrated absorption, at a pressure of 760 mm of mercury, of the multiple line between 52 kmcs and 68 kmcs produces a spectrum best fitted by a calculated spectrum whose line breadth constant is 0.02 $cm^{-1}$.

Electromagnetic Research Corp., Washington, D. C.
THE TRADEWIND INVERSION AS A TRANSOCEANIC DUCT, by M. Katzon, H. Pezzner and others. Final rept. Part 2 on Contract AF 19(604)3031. 27 May 59, 56p. 10 refs. Rept. no. CRC-3031-3; AFCRC TR-58-360(II); AD-211 604.
Order from LC mi$3.60, ph$9.30 PB 142 774

Radiosonde date for stations in the South Atlantic trade wind belt are analyzed to determine the potentialities of the trade wind inversion as an elevated duct for transoceanic radio transmission. These were supplemented by refractometer soundings made by an aircraft during the latter part of 1958. These records indicate that a duct is present in the majority of the cases. Since it is known that the radiosonde underestimates ducting because of its slow response, it is concluded that a duct is present practically all the time. On the basis of the data analyzed, a specific experiment with two aircraft is proposed to test the propagation potentialities of this mechanism. A frequency of around 200 mc is recommended.

Institute of Mathematical Sciences, New York U., N. Y.
BACK SCATTERING FROM A FINITE CONE, by Joseph B. Keller. Rept. on Contract AF 19(604)1717. Feb 59, 25p. 15 refs. Research rept. no. EM-127; AFCRC-TN-59-144; AD-211 808.
Order from LC Mi$2.70, ph$4.80 PB 142 500

Back scattering is calculated for an acoustic wave incident on a hard or soft finite cone, and an electromagnetic wave incident on a perfectly conducting finite cone. Two shapes of cone are treated, one with a flat base and the other with a rounded base. The calculation is based on the geometrical theory of diffraction. Therefore it is valid for wavelengths as large as the cone dimensions or smaller. Graphs of the back scattering cross-section versus cone angle and versus wavelength are given for axial incidence on the flat-based cone. Suggestions for shaping an object to minimize its back scattering are also included.

Lincoln Lab., Mass. Inst. of Tech., Lexington.
ON THE RECIPROCITY OF RAYS PROPAGATED THROUGH A HORIZONTALLY STRATIFIED IONOSPHERE, by D. H. Archer. Rept. on Contract AF 19(122)458. 18 Dec 58, 20p. 4 refs. Technical rept. no. 168; AD-110 032.
Order from LC mi$2.40, ph$3.30 PB 142 520

By employing the theory developed by Booker for the propagation of magneto-ionic wave packets through a horizontally stratified ionosphere, it is shown that the path, time of flight and attenuation of waves transmitted in opposite directions between two stations on the earth are the same. As a simple extension, it is shown that the results are valid for an ionosphere that is tilted with respect to the earth's surface. A reciprocity theorem for plane waves propagated in the magnetic meridian has been proved by Budden. This work is based upon the full-wave theory, and is therefore valid for all wavelengths. It is shown in this report that under the ray approximation the theorem is valid for propagation in any direction.

Lincoln Lab., Mass. Inst. of Tech., Cambridge.
PHASE AND AMPLITUDE VARIABILITY IN MEDIUM-FREQUENCY IONOSPHERIC TRANSMISSION, by D. G. Brennan and M. Lindeman Phillips. Rept. on Contract AF 19(122)458. 16 Sep 57, 383p. 29 refs. Technical rept. no. 93; AD-110 016.
Order from LC mi$11.10, ph$59.10 PB 142 438

An extensive and detailed study of the short-term

variability of phase and amplitude in medium-frequency transmission at oblique incidence is presented. Fluctuations in both space and time are studied, and the results are compared with the theories developed by Booker, Bowhill, Bramley, Briggs, McNicol, G. J. Phillips, Ratcliffe, Shinn, and others. A substantial body of experimental data, including over 400 auto- and cross-correlograms, is presented. The experimental results were largely obtained from one-hop E-layer transmission at 543 kcps (553 meters), essentially uncontaminated by ground-wave or multiple-hop modes. Certain applications of the results to the design of communication and navigation systems are illustrated.

Materials Research Lab., Watertown Arsenal, Mass.
A STUDY OF THE COMPTON SCATTERING OF X-RAYS. II. Li, $Li^+$, Be, Na, $Na^+$, Al, $Al^{+3}$, $K^+$, $Cl^-$, Ca, $Ca^+$, AND $Ca^{+2}$, by A. J. Freeman. June 59, 26p. 17 refs. MRL rept. no. 63; AD-216 628.
Order from LC mi$2.70, ph$4.80 PB 142 719

Following the methods of a previous paper, the Compton incoherent scattering functions for Li, $Li^+$, Be, Na, $Na^+$, $Al^+$, $Al^{+3}$, $K^+$, $Cl^-$, Ca, $Ca^+$ and $Ca^{+2}$ have been calculated using Hartree-Fock self-consistent-field wave functions. As was found earlier, the exchange terms in the Waller-Hartree expression are of considerable importance for obtaining accurate values of the incoherent scattering intensities. Comparison is made with earlier calculations and with the experiments of Laval on KCl, and Cribier on $CaF_2$.

Stanford Research Inst., Menlo Park, Calif.
UPPER ATMOSPHERE CLUTTER RESEARCH. PART I: EXPERIMENTAL RADARS FOR RADIO PROPAGATION STUDIES, by R. I. Leadabrand, Lambert Dolphin, and A. M. Peterson. Final rept. pt. 1 on Contract AF 30(602)1462. Oct 57, 86p. RADC-TR-58-2A; AD-148 534.
Order from LC mi$4.80, ph$13.80 PB 142 576

This report describes the design, construction, and operation of two radar equipments that are especially suitable for studies of radar reflections from auroral and meteoric ionization. These radars are adaptable to other types of radio propagation and radio astronomy studies and will be used for moon reflection studies. One of the radars operates at a frequency of 100 Mc and is located at the Stanford Research Institute field site near Palo Alto, California. The other, which operates at 200 or 400 Mc, is located at College, Alaska.

## RESEARCH METHODS, TECHNIQUES AND EQUIPMENT

Florida State U., Tallahassee.
A MODERATELY VERSATILE PROGRAM CIRCUIT FOR COUNTING EXPERIMENTS, by Richard D. Deslattes and Dewey L. Clemmons, Jr. Technical rept. no. 3 on Contract AF 18(603)64. 1958, 13p. AFOSR TN-58-601; AD-162 126.
Order from LC mi$2.40, ph$3.30 PB 139 311

Experimental surveys involving simple measurements are particularly adaptable to the use of automatic techniques. Particle counting measurements where certain maximum rates are established by either the dead time of the electronic circuitry or by the strength of available sources are especially tedious in the absence of automatic equipment, since good experimental practice demands that the total number of counts required to achieve the desired statistical accuracy be accumulated in small samples to guard against systematic errors. An element basic to an automatic measuring system is a program circuit to control the counting equipment, the recording of data and the simple servo motions required in changing absorbers, samples, wavelengths, etc. The device which will be discussed here was designed to execute various measurements in absorption and emission spectroscopy utilizing a two-crystal X-ray spectrometer. Its versatility is such, however, as to suggest applications to counting experiments in general. Its design is open, so that sequential procedures of arbitrary complexity may be executed by means of simple extensions of the circuitry.

Institute of Optics, U. of Rochester, N. Y.
METHODS OF EVALUATING IMAGES PRODUCED ON FILM BY PHOTOGRAPHIC OBJECTIVES, by R. E. Hopkins, J. A. Eyer, and V. J. Carpenter. Quarterly rept. no. 5, 15 June-15 Sep 57, on Contract DA 36-039-sc-72400. 15 Sep 57, 26p. 2 refs. AD-147 104.
Order from LC mi$2.70, ph$4.80 PB 142 701

The damping constants of several photographic emulsions have been measured experimentally for specified development conditions; knowledge of these constants enables one to predict the spatial frequency response of the emulsions. In addition the variation of the damping constants with developer employed has been studied for Panatomic-X sheet film. In general, the results are consistent with the linear differential equation treatment previously suggested, which implies that micro nonlinearity is not significantly present for many film-developer combinations. However, border fringes have been observed on some edges developed in Microdol, and it can be shown that the two-constant model does not accurately predict the response of these emulsions. Evaluation of the resolving power of lens-film combinations is facilitated if it can be assumed that the spread functions of lens and film are Gaussian. The accuracy of this assumption is investigated. A method is given for obtaining the 30% spot size from a film's frequency response so that the formula may be adapted to other emulsions.

Naval Research Lab., Washington, D. C.
PLANNING PHILOSOPHY FOR COMPLEX SYSTEMS, by P. Waterman, W. Hodgson and C. Francis. Interim rept. 3 Aug 59, 12p. NRL rept. 5343.
Order from OTS $0.50 PB 151 764

The development of any complex system should be based upon a preplanned, orderly, and clearly defined system approach. The flow of events required to develop a suitable end product is described. The process begins with the existence of a need for the system,

its general description, and a statement of performance requirements to accomplish its mission. The requirement concept permits definition of a group of functional elements which, in combination, can accomplish the required mission. Technical analysis of the functional system can confirm (or suggest changes in) feasibility of the initial system concept. Analyses are followed by design studies that provide the basis for system mechanizations and equipment specifications. Theoretical mechanization requirements are validated by the design, construction, and evaluation of an experimental model. It is emphasized that "evaluation" is on a systems basis, in terms of the relationship of subsystem performance to mission accomplishment. Permissible tolerances can thereby be determined and specified in contrast to the "best possible" requirement usually imposed.

Zator Co., Cambridge, Mass.
THE MECHANIZATION OF LINGUISTIC LEARNING, by R. J. Solomonoff. Rept. on Contract AF 49(638)376. Apr 59, 19p. 3 refs. ZTB-125; AFOSR-TN-59-246; AD-212 226.
Order from LC mi$2.40, ph$3.30 PB 142 498

Paper presented at the Second International Congress on Cybernetics, Association for Cybernetics, Namur, Belgium, 3-10 Sep 58.

Some methods were obtained for the mechanization of linguistic learning, which is of interest in information retrieval, mechanical translation and linguistic analysis. Routines were devised for discovering the grammatical rules of certain elementary language types in a suitable training situation. One of the routines is for the discovery of the grammars of phrase structure languages a problem that has not yet been satisfactorily dealt with. This method is an extension of techniques for the mechanization of inductive inference previously developed for solving problems in arithmetic learning. In as much as most of English appears to be describable as a phrase structure language (though it is not at all economical to express English grammar rules in this form), the above method may be of some importance in analysis of ethnic languages. In some idealized cases the problem of learning to translate languages is considered as a problem in discovering the grammar rules of a new type of generalized language. An example is shown in which learning to translate between two phase structure languages is identical with discovering the grammar rules of a new kind of phrase structure language.

## SOCIAL SCIENCES

American Geographical Society, New York.
EGYPT: A COMPENDIUM, by Raye R. Platt and Mohammed Bahy Hefny. Rept. on Contract Nonr-641(01). May 58, 449p. 14 refs. AD-202 469.
Order from LC mi$11.10, ph$68.10 PB 139 336

This is designed to facilitate easy access to information of a comprehensive nature on the resources, economy, and external characteristics of the population of Egypt, together with the necessary background material. The subject matter of the compendium can conveniently be divided into three parts. Part I (chapters 1 to 3) provides an historical and geographical introduction of Egypt and a description of the population today. Part II (chapter 4 through 7) deals with land and livelihood, the traditional economy of the country. Part III (chapters 8 through 12) deals with Egypt as a modern industrial and strategic power.

Center for Documentation and Communication Research, Western Reserve U., Cleveland, Ohio.
SOME STATISTICAL SAMPLING CONCEPTS APPLIED TO THE INFORMATION RETRIEVAL PROCESS OF DOCUMENTATION SYSTEMS, by Harrison M. Wadsworth and Robert B. Booth. Technical note no. 4 on Contract AF 49(638)357. 19 Aug 58, 38p. 2 refs. AFOSR TN-58-765; AD-201 864.
Order from LC mi$3.00, ph$6.30 PB 139 397

Statistical sampling theory is used to develop formulas which express the probability of retrieval of any desired number of pertinent entries in a documentation system. The use of the hypergeometric and binomial distributions is shown along with approximate methods using the normal and Poisson distributions.

National Bureau of Standards, Washington, D. C.
SOME APPLICATIONS OF STATISTICAL SAMPLING METHODS TO OUTGOING LETTER MAIL CHARACTERISTICS, by Norman C. Severo, Arthur E. Newman and others. July 59, 129p. 8 refs. Technical note no. 16.
Order from OTS $2.75 PB 151 375

This paper presents applications of statistical sampling procedures especially devised to procure information about the characteristics of outgoing letter mail. The results of four separate studies carried out in the Washington, D. C., San Francisco, and Los Angeles post offices are herein summarized. The techniques used in the various studies were developed so that the required information would be of predetermined reliability and could be gathered without the use of a large staff and without interrupting the flow of mail. The four studies presented concern: (1) letter size and color characteristics, (2) ratio of hand canceled mail, (3) top and bottom clearance space of an addressed envelope, (4) proportions of long and short letters.

Pennsylvania State U. Mineral Industries Experiment Station, University Park.
THE PORT OF GENOVA: EXTERNAL AND INTERNAL RELATIONS, by Allan Rodgers. Rept. no. 2 on Contract Nonr-656(11). Apr 58, 61p. 15 refs.
Order from LC mi$3.90, ph$10.80 PB 142 563

This paper is concerned with an analysis and interpretation of some of the existing relationships between the port of Genova, its overseas "foreland", and its

internal hinterland. It is felt that a study of these spatial interchanges can provide important keys to an understanding of the present structure and possible future development of this port

## MISCELLANEOUS

Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS, Oct 59.
Order from OTS $1.25, $10.00/year PB 151 343

Contents:
Articles:
Project Sunflare II, by T. A. Chubb, R. W. Kreplin, D. P. McNutt, and H. Friedman
An NRL contribution to safer surgery, by D. Friedman
Space simulation with a high-rate pumping system, by W. W. Balwanz
Scientific Program:
Chemistry: Constitutive relations in the wetting of low-energy surfaces and the theory of the retraction method of preparing monolayers. Surface activity of fluorinated organic compounds at organic liquid/air interfaces, part 3, equation of state of adsorbed monolayers and work of adsorption of a fluorocarbon group. Low-hazard linings for steel fuel-storage tanks. Effect of hydrogen pressure on the hydrogen overvoltage on bright rhodium
Mechanics: Measurement of mechanical impedance by transient analysis. Influence of temperature elevation on the penetration of missiles into copper targets
Metallurgy and Ceramics: Effect of cold work on the creep and rupture properties of nickel. Results of applied magnetic field during irradiation upon domain-wall stabilization in Fe-Ni type alloys. Remotely operated Charpy test machine for radioactive specimens. Attack of mild steel by caustic solutions at 316°C
Nuclear and Atomic Physics: High-efficiency, long-lived vacuum cold trap for nuclear particle accelerators. Neutron-absorbing bricks made from calcium boride powder
Optics: Effect of temperature on the luminance of phosphorescent and fluorescent material used for aids to military activity in the dark
Radio: Zero crossing problem in radio-frequency measurements. CRT detectability with transparent and opaque phosphors
Sound: Theory of the thick-shell, hollow piezoceramic-sphere underwater sound transducer
Supporting Techniques: "Micronically" adjustable slit

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## General

Cushioning materials for packaging, by Frances Strachwitz. Sandia Corp. Albuquerque, N. Mex. May 1959. Order from OTS. 75 cents. SCR-81

Availability listing of reports. Abstracted in nuclear science abstracts. United States Atomic Energy Commission. Technical Information Service, Oak Ridge, Tenn. Jun 1959. 494p. Order from OTS. $5.00. TID-4000(4th Edition)

Radioactivity associated with underground nuclear explosions, by Roger E. Batzel. Univ. of California. Lawrence Radiation Lab., Livermore, Calif. Jun 1959. Contract W-7405-eng-48. 15p. Order from OTS. 50 cents. UCRL-5623

Operation TEAPOT---project 1.7. Underground explosion effects, by D. C. Sachs and L. M. Swift. Stanford Research Institute. Menlo Park, Calif. February-May, 1955. 113p. Order from OTS. $2.50. WT-1106(Del.)

## Biology and Medicine

Tissue reactions to intrapulmonary radiation. Progress report to November 1957, by Marvin Kuschner and others. Institute of Industrial Medicine. New York University-Bellevue Medical Center, New York, N. Y. n.d. Contract AT(30-1)-1925. Order from LC. Mi $3.00, ph $6.30. AECU-4178

Effect of ionizing radiation on the viability and antigenicity of pathogens of domesticated animals. Progress report (annual) - second year from May 1, 1958 through April 30, 1959. State College. Veterinary Medicine and Institute for Atomic Research. Veterinary Medical Research Institute, Ames, Iowa. 1959. Contract AT(11-1)-59, project 10, suppl. 1. 36p. Order from LC. Mi $3.00, ph $6.30. AECU-4238

Radiological physics division semiannual report for July through December 1958, by J. E. Rose and L. D. Marinelli. Argonne National Lab. Lemont, Ill. May 1959. Contract W-31-109-eng-38. 222p. Order from OTS. $3.50. ANL-5967

On the passage of pairs of elements through food chains, by H. A. Kornberg. Hanford Atomic Products Operation. Richland, Wash. May 1959. Contract W-31-109-Eng-52. 36p. Order from OTS. $1.00. HW-60127

Symposium on health physics in biology and cine held at the University of Puerto Rico, School of Medicine, San Juan. May 26-28, 1958. University of Puerto Rico. School of Medicine, San Juan, Puerto Rico and United States Atomic Energy Commission. Division of International Affairs, Washington, D. C. Jun 1959. 218p. Order from OTS. $2.00. TID-7572

Field studies of fission product inhalation. Part I. Fission product inhalation following an experimental in-pile meltdown, by Robert G. Thomas and others. University of Rochester. Atomic Energy Project, Rochester, N. Y. Aug 1959. Contract W-7401-eng-49. 20p. Order from OTS. 75 cents. UR-544

## Chemistry—General

Separation of rare earths at Amalgam Cathodes III. The separation of samarium from gadolinium, by E. I. Onstott. Univ. of California. Los Alamos Scientific Lab. Los Alamos, N. Mex. n.d. 15p. Order from LC. Mi $2.40, ph $3.30. AECU-4212

Literature survey on calcium hydride, by Eugene P. Kib. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio. Jul 1959. Contracts AF 33 (600)-38062 and AT(11-1)-171. 57p. Order from OTS. $1.75. APEX-485

A new standardization technique for X-ray absorption measurements, by J. O. Hibbits and others. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio. Aug 1959. Contracts AF 33(600)-38062 and AT(11-1)-171. 7p. Order from OTS. 50 cents. APEX-506

Heavy water production methods, by F. G. McCullough. Oak Ridge National Lab. Oak Ridge, Tenn. Feb 1953. 11p. Order from LC. Mi $2.40, ph $3.30. CF-53-2-48(Del.)

Crystal structures of some compounds of $UF_4$ and $ThF_4$ with alkali fluorides, by W. R. Grimes. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Dec 1958. 5p. Order from LC. Mi $1.80, ph $1.80. CF-58-12-40

Flooding characteristics of 1/4-in. fluorothene raschig rings, by R. L. Boles and S. H. Stainker. Union Carbide Nuclear Co. Oak Ridge National Lab. Oak Ridge, Tenn. Apr 1959. 14p. Order from LC. Mi $2.40, ph $3.30. CF-59-4-83

Eurochemic Assistance: Chemical technology div. Unit operations section monthly progress report, December, 1958. (Sections 5.0, 6.0, 8.0), by E. M. Shank. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. May 1959. 27p. Order from LC. Mi $2.70, ph $4.80. CF-59-5-2

The development of a fluidized bed reactor for the fluorox process: Unit operations monthly status reports for the period November, 1958 through May, 1959, by J. C. Bresee and others. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. May 1959. 41p. Order from LC. Mi $3.30, ph $7.80. CF-59-5-93

The reaction of uranium dioxide with uranium hexafluoride, by G. A. Rampy. Goodyear Atomic Corp. Portsmouth, Ohio. Jun 1959. Contract AT-(33-2)-1. 28p. Order from OTS. $1.00. GAT-265

Dejacketing of zircaloy clad fuel elements with ammonium fluoride solutions - interim progress report, by J. L. Swanson. Hanford Atomic Products. Chemical Research and Development Operation, Richland, Wash. Apr 1957. Contract W-31-109-Eng-52. 23p. Order from LC. Mi $2.40, ph $4.80. HW-49633(Del.)

Phase relationships in mixtures of the simple polyphenyls and condensed ring aromatics -- a survey of organic reactor coolant mixtures, by V. H. Troutner. Hanford Atomic Products Operation. Richland, Wash. Aug 1958. Contract W-31-109-Eng-52. 76p. Order from OTS. $2.25. HW-57431

Zirconium fluoride phase studies. I. A preliminary investigation of solid phases, by A. G. Chapman and R. A. Woodriff. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jan 1959. Contract AT(10-1)-205. 15p. Order from OTS. 50 cents. IDO-14469

Preparation of yttrium fluoride using ammonium bifluoride, by John Walker and Edwin Olson. Iowa State University of Science and Technology. Ames Lab., Ames, Iowa. Jul 1959. Contract W-7405-eng-82. 23p. Order from OTS. 75 cents. IS-2

Extraction equipment and sampling technique used in semi-countinuous silver-uranium extraction studies, by Edwin H. Olson and others. Iowa State University of Science and Technology. Ames Lab., Ames, Iowa. Jul 1959. Contract W-7405-eng-82. 23p. Order from OTS. 75 cents. IS-3

Ionic mobilities in selected fused salt systems, by Boone B. Owens and F. R. Duke. Iowa State College. Ames Lab., Ames, Iowa. Aug 1957. Contract W-7405-eng-82. 62p. Order from OTS. $1.75. ISC-992

Chemistry semi-annual summary research report for July-December, 1958. Iowa State College. Ames Lab., Ames, Iowa. Apr 1959. Contract W-7405-eng-82. 67p. Order from OTS. $2.00. ISC-1116

The chemical determination of boron in boron carbide zirconium, clad with zircaloy, by J. Rynasiewicz and V. F. Consalvo. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. May 1959. Contract W-31-109-Eng-52. 23p. Order from LC. Mi $2.70, ph $4.80. KAPL-M-JR-12

X-ray diffraction analysis of boron in boron carbide, by L. M. Osika. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y.

May 1959. Contract W-31-109-Eng-52. 7p. Order from LC. Mi $1.80, ph $1.80. KAPL-M-LMO-4

A compilation of the debye or characteristic temperatures for elements and compounds (bibliography), by Ruth H. Lier. Jun 1959. Contract W-7405-ENG-36. 18p. Order from OTS. 75 cents. LAMS-2324

The adsorption of krypton and xenon on activated charcoal and its uses in research and industry - a bibliography, by Lawrence A. Weller. Monsanto Chemical Co. Research and Engineering Div., Mound Lab., Miamisburg, Ohio. May 1959. Contract AT-33-1-GEN-53. 22p. Order from OTS. 75 cents. MLM-1092

High temperature gas chromatography of aromatic hydrocarbons: instrument design and exploratory studies at temperature up to 430° C, by Robert A. Baxter and Robert T. Keen. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Jun 1959. Contract AT (11-1)-GEN-8. 29p. Order from OTS. $1.00. NAA-SR-3154

A. Coprecipitation from homogeneous solution. B. Analytical chemistry of thorium, by Louis Gordon and others. Syracuse University. Syracuse, N. Y. Jun 1953. Contract AT (30-1)-1213. 53p. Order from LC. Mi $3.60, ph $9.30. NYO-3191

Organic compounds in fission reactors. I. The dispersion of $ThO_2$ in nonpolar solvents, by W. H. Baldwin. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 7p. Order from OTS. 50 cents. ORNL-2758

Psychrometric studies at extreme humidities (M. S. thesis), by Loren Jens Hov. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jun 1959. Contract W-7405-eng-48 64p. Order from OTS. $1.75. UCRL-3405

Biosynthesis of morphine (thesis), by Don Robert Baker. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jul 1959. Contract W-7405-eng-48. 219p. Order from OTS. $2.50. UCRL-8576

Nuclear reactions of low-Z elements with 5.7-Bev protons: nuclear structure and simple nuclear reactions (thesis), by Paul A. Benioff. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jul 1959. Contract W-7405-eng-48. 141p. Order from OTS. $2.75. UCRL-8780

The crystal structures of several cis-1,2-dihalobenzocyclobutenes (thesis), by George Lind Hardgrove, Jr. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jun 1959. Contract W-7405-eng-48. 72p. Order from OTS. $2.00. UCRL-8803

The polarographic determination of hexavalent uranium in uranium oxides: the determination of oxygen uranium rations, by R. M. Burd and G. W. Goward. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Apr 1959. Contract AT-11-1-GEN-14. 11p. Order from OTS. 50 cents. WAPD-205

Determination of the appearance potential of the positive molecule-ion of uranium hexafluoride, by V. L. Warren and J. C. Horton. Union Carbide Nuclear Co. Union Carbide Corp., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tenn. Aug 1959. Contract W-7405-eng-26. 7p. Order from OTS. 50 cents. K-1429

## Chemistry—Radiation and Radiochemistry

Kinetics of the exchange of phosphorus in $PCl_3$-$POCl_3$ systems; effect of gamma radiation, ultraviolet light, visible light, heat and traces of water. I, by LeRoy F. Grantham and Herbert C. Moser. Kansas State Univ. Department of Chemistry, Lawrence, Kans. n.d. 15p. Order from LC. Mi $2.40, ph $3.30. AECU-4190

Experiments on the release of fission products from molten reactor fuels, by G. E. Creek and others. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 28p. Order from OTS. $1.00. ORNL-2616

## Chemistry—Separation Processes for Plutonium and Uranium

Extraction of uranium, magnesium, zirconium, and cerium from bismuth with a fused fluoride salt mixture, by Max D. Adams and others. Argonne National Lab. Lemont, Ill. Jun 1959. Contract W-31-109-eng-38. 18p. Order from OTS. 75 cents. ANL-6017

Progress report on waste processing development project calcining of wastes, by S. Zwickler and B. Manowitz. Brookhaven National Lab. Upton, N. Y. Jan 1956. Decl. Jul 1959. 12p. Order from LC. Mi $2.40, ph $3.30. BNL-381

Salt-phase chlorination of reactor fuels. I. Dissolution of zirconium alloys in lead chloride, by H. T. Hahn and E. M. Vander Wall. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. May 1959. Contract AT(10-1)-205. 19p. Order from OTS. 75 cents. IDO-14478

Removal of irradiated $UO_2$ fuel from the cladding by controlled oxidation, by L. A. Hanson. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 25p. Order from OTS. 75 cents. NAA-SR-3591

Chemical pulverization of sintered uranium dioxide bodies. Part I. (preliminary small-scale studies), by S. Strausberg and T. E. Luebben. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 61p. Order from OTS. $1.75. NAA-SR-3910

Recycle of $UO_2F_2$ in the fluorox process: Reaction of $UO_2F_2$ with hydrogen, by L. M. Ferris and R. P. Gardner. Oak Ridge National Lab. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 16p. Order from OTS. 75 cents. ORNL-2690

## Controlled Thermonuclear Processes

Oscillations of a finite cold plasma in a strong magnetic field, by John Dawson and Carl Oberman. Princeton Univ. Project Matterhorn, Princeton, N. J. Oct 1958. Contract AT(30-1)-1238. 41p. Order from OTS. $1.25. NYO-8053

Equilibrium in a toroidal system, by Harold R. Loenig. Princeton Univ. Project Matterhorn, Princeton, N. J. Jan 1959. Contract AT(30-1)-1238. 70p. Order from OTS. $2.00.NYO-8054

## Criticality Studies

A literature search, by Raymond L. Scott. United States Atomic Energy Commission. Technical Information Service, Oak Ridge, Tenn. Aug 1959. 119p. Order from OTS. $2.50. TID-3533

## Geology and Mineralogy

Airborne reconnaissance in the Valley of Fire-Muddy Mountains region, Nevada, by Donald C. Barrett and Neil Mallory. U. S. Atomic Energy Commission. Grand Junction Operations Office, Division of Raw Materials, Salt Lake Branch Office, Salt Lake City, Utah. Sep 1955. 14p. Order from OTS. 50 cents. RME-2040

Airborne reconnaissance project, Ruby Range and Sweetwater Basin, Montana, by R. G. Pruitt, Jr. and D. N. Magleby. U.S. Atomic Energy Commission. Grand Junction Operations Office, Production Evaluation Div., Salt Lake Branch, Salt Lake City, Utah. Apr 1958. 13p. Order from OTS. 50 cents. RME-2053

Some thorium deposits in western Montana and east-central Idaho, by Wayne S. Moen. U. S. Atomic Energy Commission. Grand Junction Operations Office, Salt Lake Branch Office, Salt Lake City, Utah. Mar 1957. 30p. Order from OTS. $1.00. RME-2061(Pt. I)

Geology of the uraniferous bog deposit at Pettit Ranch, Kern County, California, by W. A. Bowes and others. United States Atomic Energy Commission. Grand Junction Operations Office, Salt Lake Branch Office, Salt Lake City, Utah. Oct 1957. 28p. Order from OTS. $1.00. RME-2063(Pt. 1)

Interim report for 1958. Electrode and membrane polarization, by Theodore R. Madden and Donald J. Marshall. Massachusetts Institute of Technology. Dept. of Geology and Geophysics, Cambridge, Mass. Feb 1959. 116p. Order from OTS. $2.75. RME-3157

An analysis of the current and long-term availability of uranium and thorium raw materials for atomic energy development. United States Atomic Energy Commission. Division of Raw Materials, Technical Information Service, Oak Ridge, Tenn. Jul 1959. 8p. Order from OTS. 50 cents. TID-8201

## Health and Safety

Leaching of rainier debris, by F. L. Culler. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Apr 1959. 7p. Order from LC. Mi $1.80, ph $1.80. CF-59-4-30

Strontium program. Quarterly summary report, by Edward P. Hardy, Jr. and Stanley Klein. United States Atomic Energy Commission. Health and Safety Lab., New York Operations Office, New York, N. Y. May 1959. 202p. Order from OTS. $3.50. HASL-65

Quarterly progress report: research and development activities in the field of radiological sciences January - March, 1959, by J. W. Healy. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Apr 1959. Contract W-31-109-Eng-52. 36p. Order from OTS. $1.25. HW-60137

The tracking of fallout by means of a slowly descending balloon, by K. L. Shipley. Sandia Corp. Albuquerque, N. Mex. Apr 1958. 21p. Order from LC. Mi $2.40, ph $4.80. SC-4180(TR)

Micrometeorological variability and fallout pattern errors, by H. W. Church. Sandia Corp. Albuquerque, N. Mex. Feb 1958. Case no. 407.03. 8p. Order from LC. Mi $1.80, ph $1.80. SCTM-58(51)

Albuquerque winds aloft in relation to fallout, by C. E. Buell. Sandia Corp. Albuquerque, N. Mex. Jun 1956. Case no. 417.00. 13p. Order from LC. Mi $2.40, ph $3.30. SCTM-129-56-51

Toxicity and other hazards of beryllium and rocket propellants. A literature search, by William E. Bost. United States Atomic Energy Commission. Technical Information Service, Oak Ridge, Tenn. Jul 1959. 11p. Order from OTS. 50 cents. TID-3531

A summary of industrial accidents in USAEC facilities. United States Atomic Energy Commission. Office of Industrial Relations, Safety and Fire Protection Branch, Technical Information Service, Oak Ridge, Tenn. Aug 1959. 40p. Order from OTS. 50 cents. TID-5360(Suppl. 2)

Stratospheric radioactivity data obtained by balloon sampling, by Joshua Z. Holland. United States Atomic Energy Commission. Technical Information Service, Oak Ridge, Tenn. May 1959. 142p. Order from OTS. $1.50. TID-5555

Technical consideration on survival measures and reduction of casualties, by Robert L. Corabie Atomic Energy Commission. Civil Defense Liaison Branch, Division of Biology and Medicine, Technical Information Service Extension, Oak Ridge, Tenn. Aug 1959. 46p. Order from OTS. 50 cents. TID-5559

The statement of Dr. W. F. Libby before special subcommittee on radiation, joint committee on atomic energ public hearings on the biological and environmental effects of nuclear war. United States Atomic Energy Commission. Washington, D. C. Jun 1959. 18p. Order from OTS. 50 cents. TID-5560

Long-time ecological effects of nuclear war, by John N. Wolfe. United States Atomic Energy Commission. Division of Biology and Medicine, Environmental Sciences Branch, Technical Information Service, Oak Ridge, Tenn. Aug 1959. 5p. Order from OTS. 50 cents. TID-5561

Effects of a nuclear attack on soils and crops, by R. F. Reitemeier and R. G. Menzel. Atomic Energy Commission and Department of Agriculture, Washington, D. C. Aug 1959. 10p. Order from OTS. 50 cents. TID-5562

Biological effects of a nuclear attack. Presented at the hearings on the biological and environmental effects of nuclear war, before the special subcommittee on radiation, joint committee on atomic energy, by Gordon M. Dunning. United States Atomic Energy Commission. Division of Biology and Medicine, Radiation Effects of Weapons Branch, Technical Information Service Extension, Oak Ridge, Tenn. Sep 1959. 31p. Order from OTS. 50 cents. TID-5563

Symposium on technical methods in health physics. Riso, Denmark. United States Atomic Energy Commission. Division of International Affairs, Technical Information Service Extension, Oak Ridge, Tenn. May 1959. 126p. Order from OTS. $1.25. TID-7577

## Instruments

An X-ray diffraction camera for use at liquid helium temperature, by A. F. Schuch. Univ. of Calif. Los Alamos Scientific Lab., Los Alamos, N. Mex. n.d. 8p. Order from LC. Mi $1.80, ph $1.80. AECU-3884

Bibliography on gas scintillation counters, 1949-July 1957, by C. R. Riese. Los Alamos Scientific Lab. Technical Library, Los Alamos, N. Mex. Sep 1957. 5p. Order from LC. Mi $1.80, ph $1.80. AECU-4245

Time of flight correction for detector thickness in the MTR fast chopper time analyzer, by B. G. Nelson. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jul 1959. Contract AT(10-1)-205. 18p. Order from OTS. 50 cents. IDO-16510

Transistorized log-period amplifier, by E. J. Wade and D. S. Davidson. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 16p. Order from OTS. 75 cents. KAPL-2006

OMR control-safety rod component development tests, by J. D. Howell. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Sep 1959. Contract AT(11-1)-GEN-8. 53p. Order from OTS. $1.50. NAA-SR-3172

A fast neutron spectrometer, by G. E. Owen and P. R. Chagnon. The Johns Hopkins University. Baltimore, Md. Oct 1953. Contract AT(30-1)-1251. 39p. Order from LC. Mi $3.00, ph $6.30. NYO-3862

Microbarography instrumentation, by H. E. Hansen. Sandia Corp. Albuquerque, N. Mex. Jun 1959. 15p. Order from OTS. 50 cents. SCR-89

A study of the error involved in the near use of a radio interferometer, by G. J. Simmons - 5243. Sandia Corp. Albuquerque, N. Mex. Apr 1959. Case no. 598.20. 27p. Order from OTS. 75 cents. SCTM 122-59-(52)

Lawrence Radiation Laboratory counting handbook. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jan 1959. Contract W-7405-eng-48. 222p. Order from OTS. $3.50. UCRL-3307 Rev.

Mechanical design of a coaxial velocity spectrometer for high-energy particles, by Robert A. Kilpatrick. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Feb 1959. Contract W-7405-eng-48. 15p. Order from OTS. 50 cents. UCRL-8639

## Metallurgy and Ceramics

Quarterly report for October, November, and December 1957, by Frank G. Foote and others. Argonne National Lab. Lemont, Ill. 1957. Contract W-31-109-eng-38. 69p. Order from OTS. $2.00. ANL-5837

An automatic polishing machine for remote metallography, by F. L. Brown and others. Argonne National Lab. Lemont, Ill. Aug 1959. Contract W-31-109-eng-38. 18p. Order from OTS. 75 cents. ANL-5904

A double pulse eddy current testing system, by C. J. Renken and R. G. Myers. Argonne National Lab. Lemont, Ill. Jun 1959. Contract W-31-109-eng-38. 34p. Order from OTS. $1.00. ANL-5935

Inspection of fuel element components and fuel elements for the Argonne low power reactor, by W. J. McGonnagle and others. Argonne National Lab. Lemont, Ill. Aug 1959. Contract W-31-109-eng-38. 6p. Order from OTS. 50 cents. ANL-5951

The performance of a special differential transformer and an eddy current coil in a high gamma flux environment, by George J. Pokorny and James E. Ayer. Argonne National Lab. Lemont, Ill. Jul 1959. Contract W-31-109-eng-38. 15p. Order from OTS. 50 cents. ANL-5988

Recrystallization of deformed alpha-uranium single crystals, by L. T. Lloyd. Argonne National Lab. Lemont, Ill. Jul 1959. Contract W-31-109-eng-38. 57p. Order from OTS. $1.75. ANL-6001

Corrosion of 1100 aluminum in boiling $H_2O$ and $D_2O$, by J. E. Draley and others. Argonne National Lab. Lemont, Ill. Jul 1959. Contract W-31-eng-38. 9p. Order from OTS. 50 cents. ANL-6015

Transformation in uranium-base alloys. Summary report for December 14, 1955 - March 31, 1957. Armour Research Foundation of Illinois. Institute of Technology, Chicago, Ill. Jun 1957. ARF Proj. B 095, subcontract 73-(14-432). Prime contract AT-11-1-GEN-14. 195p. Order from LC. Mi $9.70, ph $30.30. ARF-2095-1

Progress relating to civilian applications during February, 1959, by Russel W. Dayton and Clyde R. Tipton, Jr. Battelle Memorial Inst. Columbus, Ohio. Mar 1959. Decl. Jun 1959. Contract W-7405-eng-92. 66p. Order from OTS. $2.00. BMI-1324

Progress relating to civilian applications during March, 1959, by Russell W. Dayton and Clyde R. Tipton, Jr. Battelle Memorial Inst. Columbus, Ohio. Apr 1959. Decl. Jun 1959. Contract W-7405-1ng-92. 80p. Order from OTS. $2.25. BMI-1330

Progress relating to civilian applications during April, 1959, by Russell W. Dayton and Clyde R. Tipton, Jr. Battelle Memorial Inst. Columbus,

Ohio. May 1959. Contract W-7405-eng-92. 95p. Order from OTS. $2.50. BMI-1340

Fatigue studies of INOR-8, by Raymond G. Carlsor. Battelle Memorial Inst. Columbus, Ohio. Jun 1959. Contract W-7405-eng-92. 18p. Order from OTS. 75 cents. BMI-1354

Fatigue studies of Inconel, by Raymond G. Carlson. Battelle Memorial Inst. Columbus, Ohio. Jun 1959. Contract W-7405-eng-92. 21p. Order from OTS. 75 cents. BMI-1355

The reaction of hydrogen with zirconium-1 and -25 w/o uranium alloys, by Harold E. Bigony and others. Bettelle Memorial Inst. Columbus, Ohio. Jul 1959. Contract W-7405-eng-92. 27p. Order from OTS. $1.00. BMI-1359

Reaction of nitrogen with niobium, by William M. Albrecht and W. Douglas Goode, Jr. Battelle Memorial Inst. Columbus, Ohio. Jul 1959. Contract W-7405-eng-92. 15p. Order from OTS. 75 cents. BMI-1360

Corrosion of stainless alloys in high-temperature nitrogenous environments, by Donald L. Keller. Battelle Memorial Inst. Columbus, Ohio. Jul 1959. Contract W-7405-eng-92. 49p. Order from OTS. $1.50. BMI-1361

Electron microscopical examination of bonds in zircaloy-2, by Arthur P. Young and Charles M. Schwartz. Battelle Memorial Inst. Columbus, Ohio. Jul 1959. Contracts W-7405-eng-92, NObs-65057, and index no. NS-200-023. 29p. Order from OTS. $1.00. BMI-1364

Summary of the properties of niobium, by C. K. McGlothlan. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Jan 1958. 21p. Order from LC. Mi $2.70, ph $4.80. CF-58-1-101

A carbon arc image furnace and microscope for studies at high temperatures, by H. W. Newkirk and B. B. Brenden. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. May 1959. Contract W-31-109-Eng-52. 30p. Order from OTS. $1.00. HW-59323

Interim report on creep characteristics of zircaloy-2, by P. J. Pankaskie. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Mar 1959. Contract W-31-109-Eng-52. 15p. Order from OTS. 50 cents. HW-59383 Rev.

Metallurgical development for Hanford program semi-annual report for July 1 to December 31, 1958. Iowa State College. Ames Lab., Ames, Iowa. Apr 1959. Contract W-7405-eng-82. 27p. Order from LC. Mi $2.70, ph $4.80. ISC-1144

Development of the SIC radium beryllium test source welds, by Edward and others. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. May 1959. 12p. Order from LC. Mi $2.40, ph $3.30. KAPL-M-AME-16

Report of preliminary stress-corrosion cracking tests of type-347 stainless steel capsules containing sodium hydroxide, by G. E. Galonian and H. L. Tymchyn. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 25p. Order from LC. Mi $2.70, ph $4.80. KAPL-M-GEG-12

Equipment for fatigue tests of S3G fuel cell structure sections, by G. L. Cutler and S. Beitscher. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 8p. Order from LC. Mi $1.80, ph $1.80. KAPL-M-GLE-5

Fatigue tests of S3G unit cell tube structure sections, by S. Beitscher and G. L. Cutler. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 17p. Order from LC. Mi $2.40, ph $3.30. KAPL-M-SAB-1

The behavior of aluminum galvanically coupled to ferrous alloys in water at 200°F, by D. C. Belouin. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Mar 1959. Contract W-31-109-Eng-52. 16p. Order from LC Mi $2.40, ph $3.30. KAPL-MEMO-DCB-3

An elevating turntable for remote maintenance in the processing-refabrication experiment, by Donald J. Stoker. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 27p. Order from OTS. $1.00. NAA-SR-3264

Radiation behavior of metallic fuels for sodium graphite reactors, by B. R. Hayward and L. E. Wilkinson. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 34p. Order from OTS. $1.00. NAA-SR-3411

High-strength zirconium alloys, by R. K. Wagner and H. E. Kline. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Jul 1959. Contract AT(11-1)-GEN-8. 40p. Order from OTS. $1.25. NAA-SR-3481

An evaluation of the beryllia-water vapor reaction in an open-cycle air-cooled reactor, by R. L. McKisson. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 17p. Order from OTS. NAA-SR-3619

Development and properties of coextruded zircaloy-clad uranium fuel elements with integral end seals. Terminal report to Hanford Atomic Products Operation, General Electric Co., by H. F. Sawyer. Nuclear Metals, Inc. Concord, Mass. Nov 1958. Contract AT(30-1)-1565. 78p. Order from OTS. $2.25. NMI-4710

The adaptation of new research techniques to mineral engineering problems. A bi-annual progress report for the six-month period ending 30 April 1959. Massachusetts Inst. of Technology. Dept. of Metallurgy, Cambridge, Mass. Jun 1959. Contract AT (30-1)-956. 54p. Order from OTS. $1.50. NYO-2294

Conference on recovery of enriched uranium scrap held at New York, September 23-24, 1958, by H. Werner. United States Atomic Energy Commission. Nuclear Materials Management Branch, New York Operations Office, New York, N. Y. Jul 1959. 115p. Order from OTS. $2.75. NYO-2700

Improvement of the high-temperature strength properties of reactor materials after fabrication, by R. W. Swinderman and D. A. Douglas. Oak Ridge National Lab. Oak Ridge, Tenn. Jun 1959. Contract W-7405-eng-26. 24p. Order from LC. Mi $2.70, ph $4.80. ORNL-2687

Piezoelectric ceramic materials final report for February 1, 1958 to January 31, 1959. Sandia Corporation purchase order no. 51-4232, by Don Berlincourt. Clevite Corp. Clevite Research Center, Cleveland, Ohio. 1959. 95p. Order from OTS. $2.50. SC-4306(TR)

Uranium dioxide fuel materials with improved thermal conductivity, by H. Shapiro and R. M. Powers. Sylvania-Corning Nuclear Corp. Bayside, Long Island, N. Y. Jun 1959. Contract AT(30-1)-GEN-366. 20p. Order from CTS. 75 cents. SCNC-271

Some of the things that are known and some that should be known about piezoelectric ceramic, by T. G. Kinsley. Sandia Corp. Albuquerque, N. Mex. Aug 1959. 7p. Order from OTS. 50 cents. SCR-109

The construction of underground oil storage tanks utilizing nuclear explosives, by Roland H. Carlson, 5112. Sandia Corp. Albuquerque, N. Mex. Apr 1958. Case no. 407.15. 24p. Order from CTS. 75 cents. SCTM-233-58(51)

Summaries of physical research in metallurgy, solid state physics, and ceramics, by Ralph R. Nash. United States Atomic Energy Commission. Division of Research, Washington, D. C. Jul 1959. 182p. Order from CTS. $2.75. TID-4005(Pt. 1, 5th Ed.)

Report on civilian reactor fuel elements, by M. J. Whitman and others. United States Atomic Energy Commission. Civilian Reactor Fuel Element Review Group, Washington, D. C. Jun 1959. 189p. Order from OTS. $1.75. TID-8505

Preparation and consolidation of thorium and thorium hydride powders, by R. B. Wagner and S. Storchheim. Sylvania Electric Products, Inc. Atomic Energy Division, Bayside, N. Y. Aug 1954. 36p. Order from LC. Mi $3.00, ph $6.30. SEP-168

Quarterly metallurgical progress report number 3 for the period April 1, 1959 to June 30, 1959, by Mark L. Wright. United States Dept. of Interior. Bureau of Mines, Albany Metallurgy Research Center, Region I, Albany, N. Y. Jul 1959. Contracts AT(11-1)-599, activity numbers 4203, 4240, BuShips order no. 1700S-527(1718), ammendment no. 4. 43p. Order from OTS. $1.25. USBM-U-623

High-temperature water and steam-corrosion behavior of zirconium-uranium alloys, by Stanley Kass. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jul 1959. Contract AT-11-1-GEN-14. 23p. Order from CTS. 75 cents. WAPD-TM-167

Zirconium highlights. Bettis Plant. Pittsburgh, Pa. Jun 1959. Contract AT-11-1-GEN-14. 25p. Order from LC. Mi $2.70, ph $4.80. WAPD-ZH-18

Thermoelectric nuclear fuel element. Annual progress report, by J. C. Danko and others. Westinghouse Electric Corp. Atomic Power

Dept., Pittsburgh, Pa. Apr 1959. Contract AT(30-3)-500. 113p. Order from OTS. $2.50. WCAP-1162

## Particle Accelerators and High-Voltage Machines

Concerning the $2\nu/N \rightarrow 1/3$ resonance, IV the limiting-amplitude solution of the equation

$$\frac{d^2u}{d\phi^2} + (a + b\cos 2\phi)\,u + \frac{B}{2}(\sin 2\phi)\,u^2 = 0$$

by L. Jackson Laslett. Midwestern Universities Research Association. Madison, Wisc. Jun 1959. Contract AT(11-1)-384. 15p. Order from OTS. 50 cents. MURA-463

Longitudinal space charge effects - phase boundary equations & potential kernels, by C. E. Nielsen and A. M. Sessler. Midwestern Universities. Madison, Wisc. Jun 1959. Contract AT(11-1)-384. 18p. Order from OTS. 50 cents. MURA-480

Sets of eigenvectors for volumes of revolution, by J. Van Bladel. Midwestern Universities Research Association. Madison, Wisc. Jul 1959. Contract AT(11-1)-384. 37p. Order from OTS. $1.00. MURA-481

Achieving high beam densities by superposing equilibrium orbits, by K. M. Terwilliger. Midwestern Universities Research Association. Madison, Wisc. Jul 1959. Contract AT(11-1)-384. 10p. Order from OTS. 50 cents. MURA-487

Concerning the $2\nu/N$ 1/3 resonance, IV A. A trial function for the limiting-amplitude solution of

$$\frac{d^2u}{d\phi^2} + (a + b\cos 2\phi)\,u + \frac{B}{2}(\sin 2\phi)\,u^2 = 0,$$

L. Jackson Laslett. Midwestern Universities Research Association. Madison, Wisc. Jun 1959. Contract AT(11-1)-384. 6p. Order from OTS. 50 cents. MURA-490

Deviations from adiabatic behavior during capture of particles into an R. F. bucket, by C. G. Lilliequist and K. R. Symon. Midwestern Universities Research Association. Madison, Wisc. Jul 1959. Contract AT(11-1)-384. 20p. Order from OTS. 75 cents. MURA-491

Bevatron operation and development. XVIII for May, June, July 1958, by Walter D. Hartsough. University of California. Lawrence Radiation Lab., Berkeley, Calif. Apr 1959. Contract W-7405-eng-48. 28p. Order from OTS. 75 cents. UCRL-8563

Bevatron operation and development. XIX. For August, September, October 1958, by Walter D. Hartsough. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Apr 1959. Contract W-7405-eng-48. 20p. Order from OTS. 75 cents. UCRL-8564

## Physics and Mathematics

Gas scattering loss in the electron analog, by E. D. Courant. Brookhaven National Lab. Accelerator Development Dept., Upton, L. I., N. Y. Jan 1959. 6p. Order from LC. Mi $1.80, ph $1.80. AECU-4062

A nuclear-electric propulsion system, by R. W. Bussard. 12p. Order from LC. Mi $2.40, ph $3.30. AECU-4250

Resultant procedure. A method for finding the zeros of real polynomials, by Erwin H. Bareiss. Argonne National Lab. Lemont, Ill. Jun 1959. Contract W-31-109-eng-38. 71p. Order from OTS. $2.00. ANL-5997

Analogue computer solution of the nonlinear reactor kinetics equation, by Lawrence T. Bryant and N. Frank Morehouse, Jr. Argonne National Lab. Lemont, Ill. Jul 1959. Contract W-31-109-eng-38. 31p. Order from OTS. $1.00. ANL-6027

Diffusion tensor for slab geometry, by J. R. Beeler. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio. Dec 1958. Contracts AF 33(600)-38062 and AT(11-1)-171. 12p. Order from OTS. 50 cents. APEX-488

Space-energy cell homogenization, by B. H. Duane and M. J. Stanley. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio. Aug 1958. Contracts AF 33(600)-38062 and AT (11-1)-171. 169p. Order from OTS. $3.00. APEX-489

Thermocouple temperature response studies-heat transfer by radiation only, by S. S. Stack. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept.,

Cincinnati, Ohio. Nov 1958. Req. 192-ANPG-05 622. 25p. Order from LC. Mi $2.70, ph $4.80. APEX-493

Comparison of bulk shielding reactor centerline measurements in water with predictions, by A. W. Casper. General Electric Co. Atomic Products Div., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio. Nov 1958. Contracts AF 33(600)-38062 and AT(11-1)-171. 25p. Order from OTS. $1.00. APEX-504

The role of creep in the gas-pressure-bonding process, by Stephen D. Beck and Michael A. Gedwill, Jr. Battelle Memorial Inst. Columbus, Ohio. Jun 1959. Contract W-7405-eng-92. 48p. Order from OTS. $1.50. BMI-1351

A study of the wind profile in the lowest 400 feet of the atmosphere. Progress report no. 3 for January 15, 1959 - June 15, 1959, by Irving A. Singer and Gilbert S. Raynor. For U.S. Army Signal Research and Development Lab. Fort Monmouth, N. J. Jun 1959. Brookhaven National Lab. Upton, N. Y. Jun 1959. Contracts R-65-8-99812 SC-04-91 and DA project no. 3-99-04-112. 11p. Order from OTS. 50 cents. BNL-557 (T-148)

Proposed Sherwood experiment, by John S. Luce. Carbide and Carbon Chemicals Co. Oak Ridge National Lab., Oak Ridge, Tenn. Apr 1955. Decl. Oct 1958. 6p. Order from LC. Mi $1.80, ph $1.80. CF-55-4-73

An investigation of the stability of a plasma: Steady state configurations with mass rotation, by R. C. F. Bartels. Oak Ridge National Lab. Oak Ridge, Tenn. Oct 1955. Decl. Oct 1958. 42p. Order from LC. Mi $3.30, ph $7.80. CF-55-10-51

Measurement of carbon arc density, by M. L. Halbert and others. Oak Ridge National Lab. Oak Ridge, Tenn. 11p. Order from LC. Mi $2.40, ph $3.30. CF-58-10-99

Containment properties of DCX, by T. K. Fowler and M. Rankin. Union Carbide Co. Oak Ridge National Lab., Oak Ridge, Tenn. Jun 1959. 8p. Order from LC. Mi $1.80, ph $1.80. CF-59-6-32

A determination of the absolute neutron fission cross section of $U^{235}$, by George J. Safford and Edward Melkonian. Columbis Univ. Pupin Cyclotron Lab. and George B. Pegram Lab., Dept. of Physics, New York, N. Y. May 1959. Contract AT(30-1)-Gen-72. 103p. Order from CTS. $2.50. CU-186

Computed neutron flux spectra in boron and cadmium poisoned water, by M. S. Nelkin. General Dynamics Corp. General Atomic Div., San Diego, Calif. Feb 1959. Proj. 48, Contract AT(04-3)-167. 8p. Order from LC. Mi $1.80, ph $1.80. GH-P-48-5

An analysis of a reactivity transient in irradiated thorium, by R. G. Nisle. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jul 1959. Contract AT(10-1)-205. 24p. Order from OTS. 75 cents. IDO-16513

A numerical method for computing inverse LaPlace transforms, by L. A. Schmittroth and R. L. Clayton. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. May 1959. Contract AT(10-1)-205. 18p. Order from OTS. 50 cents. IDO-16525

Operation Hardtack II, preliminary report. Earth motion measurements. Part I. Seismic studies and cavity studies, by L. M. Swift and others. Stanford Research Inst. Menlo Park, Calif. Jan 1959. Project 26.1. 58p. Order from OTS. $1.75. ITR-1702

Operation Hardtack for April - October 1958. Surface and subsurface strong motion measurements, by William R. Perret. Sandia Corp. Albuquerque, N. Mex. and Univ. of California. Lawrence Radiation Lab., Livermore, Calif. Aug 1959. Projects 26.2 and 26.10. 60p. Order from OTS. $1.75. ITR-1703

Operation Hardtack for April - October 1958. Surface motions from a series of underground nuclear tests, by D. S. Carder and others. U.S. Coast and Geodetic Survey. Dept. of Commerce, Washington, D. C. and U.S. Atomic Energy Commission. Albuquerque Operations Office, Albuquerque, N. Mex. Aug 1959. Project 26.4. 189p. Order from OTS. $2.25. ITR-1705

Operation Hardtack for April - October 1958. Phase II. Preliminary report on medium studies, by B. Perkins, Jr. and A. A. Thompson. Headquarters Field Command. Defense Atomic Support Agency, Sandia Base, Albuquerque, N. Mex. and Ballistic Research Labs. Aberdeen Proving Ground, Md. Aug 1959. Project 26.8. 27p. Order from OTS. $1.00. ITR-1709

The intrinsic geometrical and flow properties of powder packs (part I), by A. J. deBethune. Union Carbide Corp. Union Carbide Nuclear

Corp. Union Carbide Nuclear Co., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tenn. Aug 1959. Contract W-7405-eng-26, subcontracts 342 and 521. 55p. Order from CTS. $1.50. K-1310

Rankine and absorption power cycles - selection of fluids for operation between given temperature levels, by A. A. Brooks and A. S. Berman. Union Carbide Nuclear Co. Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tenn. n.d. 45p. Order from LC. Mi $3.30, ph $7.80. K-1375

Critical flow velocities for collapse of reactor parallel-plate fuel assemblies, by Daniel R. Miller. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Aug 1958. Contract W-31-109-Eng-52. 31p. Order from CTS. $1.00. KAPL-1954

Monte Carlo analysis of a water age experiment, by C. R. Mullin. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jan 1959. Contract W-31-109-Eng-52. 10p. Order from CTS. 75 cents. KAPL-2003

Bibliography on thermal stresses and low-cycle fatigue, by D. R. Miller. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Aug 1959. Contract W-31-109-Eng-52. 31p. Order from CTS. $1.50. KAPL-2048

Reactor kinetics with the group diffusion model, by E. L. Wachspress. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. May 1959. Contract W-31-109-Eng-52. 29p. Order from LC. Mi $2.70, ph $4.80. KAPL-M-ELW-8

A generalization of the theory of flux synthesis, by E. L. Wachspress. General Electric Co. Knolls Atomis Power Lab., Schenectady, N. Y. May 1959. Contract W-31-109-Eng-52. 15p. Order from LC. Mi $2.40, ph $3.30. KAPL-M-ELW-9

Water gap peaking, by P. Buck and R. J. Roseberry. Knolls Atomic Power Lab. Schenectady, N. Y. Mar 1959. Contract W-31-109-Eng-52. 30p. Order from LC. Mi $2.70, ph $4.80. KAPL-M-PHB-1

Use of the IBM 704 in reduction of foil counting data, by W. B. Leng. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. May 1959. Contract W-31-109-Eng-52. 57p. Order from LC. Mi $3.60, ph $9.30. KAPL-M-WBL-2

PPA flux transient study. Part I - Experimental data, by W. B. Wright and others. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Apr 1959. Contract W-31-109-Eng-52. 100p. Order from LC. Mi $5.40, ph $15.30. KAPL-M-WBW-6

PPA flux transient study. Part II - Diffusion lengths and gap peaking, by W. B. Wright and F. Feiner. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. May 1959. Contract W-31-109-Eng-52. 18p. Order from LC. Mi $2.40, ph $3.30. KAPL-M-WBW-7

Gamma activity induced in $Bi_2Te_3$ by thermal neutrons, by W. E. Moore. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 17p. Order from LC Mi $2.40, ph $3.30. KAPL-M-WEM-1

Reduced delayed neutron group representations, by R. E. Skinner and E. R. Cohen. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Apr 1959. Contract AT (11-1)-GEN-8. 34p. Order from OTS. $1.00. NAA-SR-3204

Grace 1. An IBM 704-709 program designed for computing gamma-ray attenuation and heating in reactor shields, by D. S. Duncan and A. B. Speir. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Jun 1959. Contract AT(11-1)-GEN-8. 52p. Order from OTS. $1.50. NAA-SR-3719

Theoretical methods for the calculation of $D_2O$ lattices, by W. J. Brooks and N. Tralli. Nuclear Development Corp. of America. White Plains, N. Y. Jul 1959. Project II. Contract AT(30-1)-2303. 65p. Order from LC. Mi $3.90, ph $10.80. NDA-84-24(Vol. 1)

Papers presented at the second international conference on the peaceful uses of atomic energy, Geneva, September 1958. New York University. Institute of Mathematical Sciences, AEC Computing and Applied Mathematics, New York, N. Y. Jan 1959. Contract AT(30-1)-1480. 125p. Order from LC. Mi $6.30, ph $19.80. NYO-2538

Diode-steered linear magnetic-core memory, by A. Melmed and R. Shevlin. New York University. Institute of Mathematical Sciences, AEC Computing and Applied Mathematics Center, New York, N. Y. May 1959. Contract AT(30-1)-1480. 23p. Order from LC. Mi $2.70, ph $4.80. NYO-2541

Times constants for solid circular coils of rectangular cross section, by Richard M. Rosen. Princeton Univ. Princeton, N. J. Sep 1956. Project Matterhorn. 13p. Order from LC. Mi $2.40, ph $3.30. NYO-6376

Capture of electrons in molecular oxygen, by G. S. Hurst and T. E. Bortner. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 125p. Order from OTS. $2.75. ORNL-2670

A table of three exponential integrals, by D. K. Trubey. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 63p. Order from OTS. $1.75. ORNL-2750

A study of the principles, theory and practice of high-frequency titrimetry, by Grove Kassner. Univ. of Alabama. Tuscaloosa, Ala. n.d. Final report. Contract AT(40-1)-1354. 48p. Order from LC. Mi $3.30, ph $7.80. ORC-203

Relativistic hydrodynamics, by A. H. Taub. Sandia Corp. Research Colloquium, Albuquerque, N. Mex. Mar 1959. 18p. Order from OTS. 75 cents. SCR-67

Transport theory and spectral problems, by G. Milton Wing. Sandia Corp. Albuquerque, N. Mex. May 1959. 20p. Order from OTS. 75 cents. SCR-88

High time resolution telemetry by microwave RF link, by C. E. Ingersoll. Sandia Corp. Albuquerque, N. Mex. May 1959. 10p. Order from LC. Mi $1.80, ph $1.80. SCR-91

The electrical behavior of fine wires exploded by a coaxial cable discharge system, by T. J. Tucker and F. W. Neilson. Sandia Corp. Albuquerque, N. Mex. May 1959. 14p. Order from OTS. 50 cents. SCR-92

Large exploding wires - correlation to small wires and pause time versus length dependency, by E. C. Cnare and F. W. Neilson. Sandia Corp. Albuquerque, N. Mex. May 1959. 15p. Order from OTS. 50 cents. SCR-93

Use of the "action integral" in EW studies, by G. W. Anderson and F. W. Neilson. Sandia Corp. Albuquerque, N. Mex. May 1959. 9p. Order from OTS. 50 cents. SCR-94

Generalized functions of green for systems of ordinary differential equations, by Oswald Wyler. Sandia Corp. Albuquerque, N. Mex. Jul 1959. 23p. Order from OTS. 75 cents. SCR-98

Information, communication, and language, by Preston C. Hammer. Sandia Corp. Research Colloquium, Albuquerque, N. Mex. Jul 1959. 13p. Order from OTS. 50 cents. SCR-102

Some microwave studies of gaseous plasmas, by L. Goldstein. Sandia Corp. Research Colloquium, Albuquerque, N. Mex. Jul 1959. 32p. Order from OTS. $1.00. SCR-104

The relationship of the binomial probability distribution to other probability distributions with a selected bibliography on the subject, by D. B. Owen and E. J. Gilbert. Sandia Corp. Albuquerque, N. Mex. Jun 1959. Case no. 417.00. 22p. Order from LC. Mi $2.70, ph $4.80. SCTM-1-59(51)

High "G" testing of small weapon components, by Allan F. Beck. Sandia Corp. Albuquerque, N. Mex. Apr 1956. Case no. 590.00. 10p. Order from LC. Mi $1.80, ph $1.80. SCTM-78-56-51

A survey of the literature on inelastic collisions of electrons and hydrogen ions with hydrogen molecules, by G. W. McClure - 5152. Sandia Corp. Albuquerque, N. Mex. May 1959. Case no. 741.00. 28p. Order from OTS. 75 cents. SCTM 179-59(51)

A series of programs for computing some meteorological functions, by G. D. Byrne. Sandia Corp. Albuquerque, N. Mex. Aug 1958. Contract AT-(29-1)-789. 102p. Order from LC. Mi $5.70, ph $16.80. SCTM 290-58(51)

Report on surface acceleration measurements, USGS tunnel, room B, Nevada test site, 5 April 1957, by Stanley E. Warner. Univ. of California. Radiation Lab., Livermore, Calif. May 1957. Contract W-7405-eng-48. 33p. Order from LC. Mi $3.00, ph $6.30. UCRL-4913

The scattering of neutrons from polycrystalline materials, by Walter Marshall and Richard N. Stuart. Univ. of California. Lawrence Radiation Lab., Livermore, Calif. Apr 1959. Contract W-7405-eng-48. 32p. Order from OTS. $1.00. UCRL-5568

A practical guide to the method of least squares, by Peter Cziffra and Michael J. Moravcsik.

Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jun 1959. Contract W-7405-eng-48. 26p. Order from OTS. 75 cents. UCRL-8523 Rev.

Complete determination of polarization for a high-energy deuteron beam (thesis), by Janice Button. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 128p. Order from OTS. $2.75. UCRL-8691

Spins, moments, and hyperfine structures of some bromine isotopes (thesis), by Thomas Myer Green, III. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jun 1959. Contract W-7405-eng-48. 112p. Order from OTS. $2.50. UCRL-8730

Scattering of $K^+$ mesons off protons (thesis), by Thaddeus Francis Kycia. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 82p. Order from OTS. $2.25. UCRL-8753

Production and decay of the $K^0$ meson (thesis), by Sherwood Parker. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 91p. Order from OTS. $2.25. UCRL-8754

$K^-$ deuteron interactions in flight (M. S. thesis), by Paul G. White, Jr. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 24p. Order from OTS. 75 cents. UCRL-8759

The mean fission-fragment range in bismuth as applied to pulse-type ion chambers, by James W. Beasley. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 35p. Order from OTS. $1.00. UCRL-8760

Range-energy measurements for 742-Mev protons, by John E. Ward. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 41p. Order from OTS. $1.25. UCRL-8762

Beam-profile indicator for 184-inch cyclotron, by Robert L. Brown. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 19p. Order from OTS. 75 cents. UCRL-8767

$K^-$ scattering in deuterium at 100 to 250 Mev/c, by Vincent J. Manara, Jr. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. May 1959. Contract W-7405-eng-48. 49p. Order from OTS. $1.50. UCRL-8772

Positive-pion production by negative pions (thesis), by Walton A. Perkins, III. Univ. of California. Lawrence Radiation Lab., Berkeley, Calif. Jun 1959. Contract W-7405-eng-48. 62p. Order from OTS. $1.75. UCRL-8778

WANDA - a one-dimensional few-group diffusion equation code for the IBM-704, by O. J. Marlowe. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jul 1959. Contract AT-11-1-GEN-14. 26p. Order from OTS. $1.00. WAPD-TM-28

Critical experiments with a seed and blanket geometry assembly, by S. H. Levine and others. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jul 1959. Contract AT-11-1-GEN-14. 94p. Order from OTS. $2.25. WAPD-TM-130

P1MG - a one-dimensional multigroup $P_1$ code for the IBM-704, by H. Bohl, Jr. and others. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jul 1959. Contract AT-11-1-GEN-14. 72p. Order from OTS. $2.00. WAPD-TM-135

An application of Spencer's method to the Stieltjes and Hamburger moment problems, by W. H. Guilinger. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jul 1959. Contract AT-11-1-GEN-14. 16p. Order from OTS. 75 cents. WAPD-TM-165

The set codes - IBM 704 codes for the calculation of the stresses in a pressure vessel with an ellipsoidal head, by G. G. Bilodeau and others. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Jun 1959. Contract AT-11-1-GEN-14. 29p. Order from OTS. $1.00. WAPD-TM-174

Isotopic concentrations for a time-varying irradiation of uranium or plutonium, by S. B. Gunst. Westinghouse Electric Corp. Bettis Atomic Power Div., Bettis Plant, Pittsburgh, Pa. Aug 1959. Contract AT-11-1-GEN-14. 39p. Order from OTS. $1.25. WAPD-TM-191

## Progress Reports

Technical report no. 7. The Anderson Physical Lab. Champaign, Ill. Apr 1959. Contract

AT(11-1)-544. 21p. Order from LC. Mi $2.70, ph $4.80. AECU-4234

Quarterly progress report for January 1 - March 31, 1959. Brookhaven National Lab. Associated Universities, Inc., Upton, N. Y. 1959. 50p. Order from CTS. $1.50. BNL 550 (S-49)

Quarterly status report of the LASL plasma thermocouple development program for period ending June 20, 1959, by Samuel Glasstone. Univ. of California. Los Alamos Scientific Lab., Los Alamos, N. Mex. Jul 1959. Contract W-7405-ENG-36. 14p. Order from CTS. 50 cents. LAMS-2333

Annual technical progress report AEC unclassified programs for fiscal year 1959. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT (11-1)-GEN-8. 397p. Order from OTS. $6.70. NAA-SR-3850

Monthly progress report for June 1959. For Yankee Atomic Electric Co. Westinghouse Electric Corp., Pittsburgh, Pa. Jul 1959. Subcontract AT(30-3)-222. 12p. Order from LC. Mi $2.40, ph $3.30. YAEC-134

## Radioactive Waste

Hydrologic and tracer studies in Mohawk River at Knolls Atomic Power Laboratory, by E. S. Simpson and others. U. S. Geological Survey. Schenectady Naval Reactors Operations Office, U. S. Atomic Energy Commission, Schenectady, N. Y. Jul 1959. 301p. Order from CTS. $5.00. SO-45

## Reactors—General

Argonne high-flux research reactor - AHFR conceptual design study, by L. E. Link and others. Argonne National Lab., Lemont, Ill. Jun 1959. Contract W-31-109-eng-38. 87p. Order from CTS. $2.00. ANL-5983

Analysis of neutron pulses in a godiva-type reactor, by C. W. Nestor and Melvin Tobias. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Feb 1959. 17p. Order from LC. Mi $2.40, ph $3.30. CF-59-2-78

The effect of radiation on petroleum and its products, by E. F. Baxter, Jr. and J. F. Black. For U.S. Maritime Administration. Nuclear Projects Office. Esso Research and Engineering Co. Products Research Div., Linden, N. J. Aug 1959. Contract MA-1814. 16p. Order from OTS. 50 cents. ESSO-MA-1

The application of petroleum and petroleum products as shielding in nuclear propelled tankers, by E. F. Baxter, Jr. and J. F. Black. For U. S. Maritime Administration. Nuclear Projects Office. Esso Research and Engineering Co. Products Research Div., Linden, N. J. Aug 1959. Contract MA-1814. 9p. Order from OTS. 50 cents. ESSO-MA-2

The application of petroleum products as moderator-coolants in marine propulsion reactors, by E. F. Baxter, Jr. and J. F. Black. For U. S. Maritime Administration. Nuclear Projects Office. Esso Research and Engineering Co. Products Research Div., Linden, N. J. Aug 1959. Contract MA-1814. 13p. Order from OTS. 50 cents. ESSO-MA-3

Lubrication requirements of nuclear-powered surface vessels, by E. H. Okrent. For U.S. Maritime Administration. Nuclear Projects Office. Esso Research and Engineering Co. Products Research Div., Linden, N. J. Aug 1959. Contract MA-1814. 64p. Order from OTS. $1.75. ESSO-MA-4

The simulation of the plutonium recycle test reactor on an analog computer, by W. D. Cameron. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Jun 1959. Contract W-31-109-Eng-52. 93p. Order from OTS. $2.25. HW-59932

Addendum to instrument and electrical standard practices for MTR and ETR, by L. H. Jones. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jul 1959. Contract AT(10-1)-205. 12p. Order from OTS. 50 cents. IDO-16395 (Addendum)

MTR-ETR technical branches quarterly report ending December 31, 1958, by J. R. Huffman and others. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jun 1959. Contract AT(10-1)-205 65p. Order from OTS. $1.75. IDO-16532

Reactor power transients as calculated by the space independent reactor equations, by K. V. Moore and W. J. Byron. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jun 1959. Contract AT (10-1)-205. 21p. Order from OTS. 75 cents. IDO-16534

Core power variation and fuel burnup in the engineering test reactor, by L. J. Harrison. Phillips Petroleum Co. Atomic Energy Div., Idaho Operations Office, Idaho Falls, Idaho. Jul 1959. Contract AT(10-1)-205. 34p. Order from OTS. $1.00. IDO-16540

Reactor technology report no. 9 - engineering. General Electric Co. Knolls Atomic Power Lab., Schenectady, N. Y. Jun 1959. Contract W-31-109-Eng-52. 161p. Order from OTS. $3.00. KAPL-2000-6

Activation of primary coolant in molten-salt reactor, by D. J. McGoff and others. Massachusetts Inst. of Technology. Engineering Practice School, Oak Ridge, Tenn. and Union Carbide Corp. Union Carbide Nuclear Co., Oak Ridge, Tenn. Jul 1959. Contract W-7405-eng-26, subcontract 70. 28p. Order from OTS. $1.00. MIT-OR-1

Adsorption of boron on reactor slurry solids, by D. W. Jeffrey and W. L. Brassert. Massachusetts Inst. of Technology. Engineering Practice School, Oak Ridge, Tenn. and Union Carbide Corp. Union Carbide Nuclear Co., Oak Ridge, Tenn. Jul 1959. Contract W-7405-eng-26, subcontract 70. 24p. Order from OTS. 75 cents. MIT-OR-2

The effect of length on the maximum power density in a long, cylindrical reactor, by G. K. Gardiner and others. Massachusetts Inst. of Technology. Engineering Practice School. Oak Ridge, Tenn. and Union Carbide Corp. Union Carbide Nuclear Co., Oak Ridge, Tenn. Aug 1959. Contract W-7405-eng-26. 27p. Order from CTS. $1.00. MIT-OR-3

Recoil activity from stainless-steel cladding: A major contribution to coolant-stream radioactivity in GCR-2, by W. L. Brassert and others. Massachusetts Inst. of Technology. Engineering Practice School, Oak Ridge, Tenn. and Union Carbide Corp. Union Carbide Nuclear Co., Oak Ridge, Tenn. Aug 1959. Contract W-7405-eng-26. 48p. Order from OTS. $1.50. MIT-OR-4

Resonance escape probability of a lattice of multi-rod fuel elements, by C. H. Skeen and W. W. Brown. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Aug 1959. Contract AT(11-1)-GEN-8. 24p. Order from OTS. $1.00. NAA-SR-3211

Dump tank criticality and poisons for slurry reactors, by B. E. Prince. Oak Ridge National Lab. Oak Ridge, Tenn. Jul 1959. Contract W-7405-eng-26. 28p. Order from OTS. $1.00. ORNL-2708

Project aquarium: Laboratory and field corrosion tests for the Geneva Conference reactor, by J. L. English and others. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 62p. Order from OTS. $1.75. ORNL-2716

Corrosion studies for the HRT chemical processing plant, by J. L. English and others. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 42p. Order from OTS. $1.25. ORNL-2735

Boiling water reactors. An annotated bibliography of selected literature, by James M. Jacobs. Technical Information Service Extension, AEC, Oak Ridge, Tenn. Jun 1959. 52p. Order from OTS. $1.50. TID-3088

## Reactors—Power

Test results DL-S-267 T-641320. Start-up after scram. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. Apr 1959. 28p. Order from LC. Mi $2.70, ph $4.80. AECU-4202

Test results DL-S-256-S, RNI-1. Reactor refueling test. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. Apr 1959. 7p. Order from LC. Mi $1.80, ph $1.80. AECU-4203

Test results DL-S-113, T-550067. Colant charging system. Section II. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 4p. Order from LC. Mi $1.80, ph $1.80. AECU-4204

Test results DL-S-265S, RNI-8. Determining markings for fedal activity recorders. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 5p. Order from LC. Mi $1.80, ph $1.80. AECU-4205

Test results DL-S-157. Safety radiation level survey. Section II. Third performance. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 4p. Order from LC. Mi $1.80, ph $1.80. AECU-4206

Test results DL-S-266-S RNI-7. Nuclear instrumentation. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 4p. Order from LC. Mi $1.80, ph $1.80. AECU-4207

Test results DL-S-149, T-550130. Control rod positions for criticality. Section II. Second performance. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 10p. Order from LC. Mi $1.80, ph $1.80. AECU-4208

Test results DL-S-184, T-612076. Periodic radiation survey of reactor plant container and components after shutdown "B" survey. Section II. First performance. Duquesne Light Co. Shippingport Atomic Power Station., Shippingport, Pa. May 1959. 11p. Order from LC. Mi $2.40, ph $3.30. AECU-4209

Test results DL-S-212, T-641116. Isolated loop warm-up using holes in the check valves. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 11p. Order from LC. Mi $2.40, ph $3.30. AECU-4210

Test results DL-S-262-S, RNI-11. Nuclear instrumentation system operation selector switch operational information. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 8p. Order from LC. Mi $1.80, ph $1.80. AECU-4218

Test results DL-S-263, RNI-12. Checking rod control system inverters following replacement of faceplate commutators. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 9p. Order from LC. Mi $1.80, ph $1.80. AECU-4219

Test results DL-S-284-S, RNI-26. Coolant charging system fill pump temperature survey. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 7p. Order from LC. Mi $1.80, ph $1.80. AECU-4220

Test results DL-S-273S (RNI 20). Reactor plant container air cooling system pressure switches. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 4p. Order from LC. Mi $1.80, ph $1.80. AECU-4221

Test results DL-S-138, T-550092. Canal water system. Section II. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 13p. Order from LC. Mi $2.40, ph $3.30. AECU-4224

Test results DL-S-149, T-550130. Control rod positions for criticality. Section II. Sixth performance. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 12p. Order from LC. Mi $2.40, ph $3.30. AECU-4225

Test results DL-S-150, T-550131. Calibration and intercomparison of control rods. Section II. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 150p. Order from LC. Mi $7.20, ph $22.80. AECU-4226

Test results DL-S-183, T-612103. Intercalibration of nuclear instrumentation. Section V. Second performance. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 14p. Order from LC. Mi $2.40, ph $3.30. AECU-4227

Test results DL-S-259-S, RNI-15. Nuclear instrumentation shutdown source range counting rate. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. May 1959. 5p. Order from LC. Mi $1.80, ph $1.80. AECU-4228

Test results DL-S-148, T-550011. Core I control rod drive mechanisms periodic tests. Section I. First throught seventh performances. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport Atomic Power Station, Shippingport, Pa. Jun 1959. 32p. Order from LC. Mi $3.00, ph $6.00. AECU-4229

Test results DL-S-286S, RNI no. 25. Reactor coolant pump noise monitor cabinet temperature. Duquesne Light Co. Power Stations Dept., Shippingport Atomic Power Station, Shippingport, Pa. n.d. 3p. Order from LC. Mi $1.80, ph $1.80. AECU-4230

Test results DL-S-300. River soundings. Section I. Duquesne Light Co. Shippingport Atomic Power Station, Shippingport, Pa. Jun 1959. 4p. Order from LC. Mi $1.80, ph $1.80. AECU-4231

Pathfinder Atomic Power Plant. Technical progress report for October 1, 1958 - December 31, 1958. Allis-Chalmers Manufacturing Co. Milwaukee, Wisc. Mar 1959. Contract AT(11-1)-589. 88p. Order from OTS. $2.25. ACNP-5904

Liquid metal fuel reactor experiment. Dynamic utility test loop, by C. H. Baker. Babcock & Wilcox Co. Atomic Energy Div., Alliance, Ohio. May 1959. Contracts AT(30-1)-1940 and AEN-46. 60p. Order from CTS. $1.75. BAW-1058

Liquid metal fuel reactor experiment. Corrosion resistance of M0-0.5% TI alloy, tantalum, and beryllium in liquid bismuth, by J. W. Seifert. Babcock & Wilcox Co. Atomic Energy Div., Aliance, Ohio. May 1959. Contracts AT(30-1)-1940 and AEJ-46. 22p. Order from OTS. 75 cents. BAW-1067

Reactivity lifetimes of slightly enriched homogeneous reactors, by Seymour Jaye and M. P. Lietzke. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Mar 1958. 16p. Order from LC. Mi $2.40, ph $3.30. CF-58-3-110

Metallographic examination of components and coupons from HRP In-Pile loop L-2-19, by A. E. Richt. Union Carbide Nuclear Co. Oak Ridge National Lab., Oak Ridge, Tenn. Jun 1958. 20p. Order from LC. Mi $2.70, ph $4.80. CF-58-6-20

S - Process Pilot Plant - First run results and process principles, by D. F. Babcock and others. E. I. du Pont de Nemours & Co. Explosives Dept. - Atomic Energy Div., Aiken, S. C. Nov 1951. Contract AT(07-2)-1. 74p. Order from LC. Mi $4.50, ph $12.30. DP-3

Frequency response of weighted voids vs. power, by J. J. Hogle. General Electric Co. Atomic Power Equip. Dept., Richland, Wash. Feb 1957. 31p. Order from LC. Mi $3.00, ph $6.30. GEAP-0971

Radial thermal flux traverses in natural uranium graphite lattices, by R. Nilson and T. J. Oakes. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. May 1959. 25p. Order from LC. Mi $2.70, ph $4.80.HW-59046

Los Alamos power reactor experiment number one LAPRE I, by R. E. Peterson. Univ. of California. Los Alamos Scientific Lab., Los Alamos, N. Mex. Jan 1959. Contract W-7405-ENG-36. 137p. Order from OTS. $2.75. LA-2292

A preliminary study of a fast reactor core test facility, by D. B. Hall and others. Univ. of California. Los Alamos Scientific Lab., Los Alamos, N. Mex. Aug 1959. Contract W-7405-ENG-36. 128p. Order from OTS. $2.75. LA-2332

Fluidized bed reactor study. Phase I - Feasibility. Martin Nuclear Co. Baltimore, Md. Feb 1959. 378p. Order from OTS. $3.50. MND-FBR-1696

A survey of the decomposition rates of organic reactor coolants, by R. H. J. Gercke and C. A. Trilling. North American Aviation, Inc. Atomics International, Canoga Park, Calif. Jun 1959. Contract AT(11-1)-GEN-8. 29p. Order from OTS. 75 cents. NAA-SR-3835

Maritime organic moderated and cooled reactor. North American Aviation, Inc. Atomics International, Canoga Park, Calif. May 1959. Contract AT(11-1)-GEN-8. 233p. Order from OTS. $3.50. NAA-SR-3859

Design development tests of some components for the 10 $MW_e$ SDR, by C. Bolta and others. Nuclear Development Corp. of America. White Plains, N. Y. May 1959. Contract AT(30-3)-256. 69p. Order from LC. Mi $3.90, ph $10.80. NDA-84-21

Progress report. Pebble Bed Reactor program for June 1, 1958 - May 31, 1959. Sanderson & Porter. New York, N. Y. 1959. Contract AT(30-1)-2207. 331p. Order from OTS. $5.00. NYO-2373

Selection of material for a tube which is subjected to a pulsating heat flux action on the inside diameter, by Michael Rashevsky. Princeton Univ. Princeton, N. J. May 1955. Project Matterhorn. 33p. Order from LC. Mi $3.00, ph $6.30. NYO-6361

Digital start-up control for aircraft reactors. Sperry Rand Corp. Ford Instrument Co., Long Island City, N. Y. Mar 1958. Contract AT(30-1)-1969. 27p. Order from OTS. 75 cents. NYO-8586

The HGCR-1. A design study of a nuclear power station employing a high-temperature gas-cooled reactor with graphite-$UO_2$ fuel elements, by W. B. Cottrell and others. Union Carbide Corp. Oak Ridge National Lab., Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 199p. Order from OTS. $3.50. ORNL-2653

Specifications and fabrication procedures for SM-1 Core II control rod fuel elements, by C. F. Leitten, Jr. and others. Union Carbide Corp.

Oak Ridge National Lab., Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 103p. Order from OTS. $2.50. CRNL-2726

Specifications and fabrication procedures on europium-bearing absorber rods for reactivity control in Core II of SM-1, by C. F. Leitten, Jr. and others. Union Carbide Corp. Oak Ridge National Lab., Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 78p. Order from OTS. $2.25. ORNL-2733

Monthly technical report. Report period March 1959. Power Reactor Development Co. Detroit, Mich. 1959. Contract AT(11-1)-476. 26p. Order from LC. Mi $2.70, ph $4.80. PRDC-TR-21

$D_2O$-moderated power reactors. A symposium held at the Atomic Energy Commission Headquarters Building, Germantown, Maryland. March 3-4, 1959. United States Atomic Energy Commission. Div. of Reactor Development, Washington, D. C. Aug 1959. 156p. Order from OTS. $1.50. TID-7575

Boiling water reactor study. 306 Mw power reactor conceptual design. EBASCC Services Inc. and General Electric Co. Richland, Wash. Mar 1959. Contract AT(10-1)-1010. 365p. Order from OTS. Total price of the three parts $5.25. TID-8500(Pt. 1)

Boiling water reactor study. Seperate studies. EBASCO Services Inc. and General Electric Co. Richland, Wash. Mar 1959. Contract AT(10-1)-1010. 171p. Order from OTS. Total price of the three parts $5.25. TID-8500(Pt. 2)

Boiling water reactor study. 306 Mw coal-fired installation. EBASCO Services Inc. U. S. Atomic Energy Commission. Div. of Reactor Development, Washington, D. C. Apr 1959. Contract AT(10-1)-1010. 44p. Order from OTS. Total price of the three parts $5.25. TID-8500(Pt. 3)

Advanced pressurized water reactor study. Phase I report. For U. S. Atomic Energy Commission. Div. of Reactor Development, Washington, D. C. Stone & Webster Engineering Corp. and Combustion Engineering, Inc. Apr 1959. Contract AT(11-1)-709. 473p. Order from OTS. Total price of the of the three parts $10.75. TID-8502(Pt. 1)

Advanced pressurized water reactor study. Appendixes to Phase I report. For U. S. Atomic Energy Commission. Div. of Reactor Development. Stone & Webster Engineering Corp. and Combustion Engineering, Inc. Apr 1959. Contract AT(11-1)-709. 497p. Order from OTS. Total price of the three parts $10.75. TID-8502(Pt. 2)

Advanced pressurized water reactor study. 235 Mw coal-fired generating plant. For U. S. Atomic Energy Commission. Division of Reactor Development, Washington, D. C. Stone & Webster Engineering Corp. and Combustion Engineering, Inc. Apr 1959. Contract AT(11-1)-709. 27p. Order from OTS. Total price of the three parts $10.75. TID-8502(Pt. 3)

Heavy water moderated power reactor plant. Design study. For U. S. Atomic Energy Commission. Division of Reactor Development, Washington, D. C. Sargent & Lundy, Engineers and Nuclear Development Corp. of America. Apr 1959. Contract AT(38-1)-193. 587p. Order from OTS. Total price of the two parts $11.25. TID-8503(Pt. 1)

Heavy water moderated power reactor plant. Preliminary design of the prototype plant. For U. S. Atomic Energy Commission. Div. of Reactor Development, Washington, D. C. Sargent & Lundy, Engineers and Nuclear Development Corp. of America. Apr 1959. Contract AT(38-1)-193. 490p. Order from OTS. Total price of the two parts $11.25. TID-8503(Pt. 2)

AEC summary and evaluation report of four power reactor design studies. USAEC. Division of Reactor Development, Washington, D. C. Aug 1959. 37p. Order from OTS. 60 cents. TID-8504

Costs of nuclear power. Atomic Energy Commission. Office of Operations Analysis and Forecasting. Washington, D. C. Jul 1959. 34p. Order from OTS. 50 cents. TID-8506

Report of the fluid fuel reactors task force to the Division of Reactor Development, United States Atomic Energy Commission. USAEC. Technical Information Services, Dept. of Commerce, Washington, D. C. Feb 1959. 197p. Order from OTS. $1.75. TID-8507

Technical progress report. Pressurized water reactor (PWR) project for the period April 24, 1959 to June 23, 1959. Westinghouse Electric Corp. Bettis Plant, Pittsburgh, Pa. 1959.

Contract AT-11-1-GEN-14. 97p. Order from OTS. $2.25. WAPD-MRP-80

Experimental measurement of mixing in parallel flow rod bundles, by W. H. Bell and B. W. LeTourneau. Westinghouse Electric Corp. Pittsburgh, Pa. n.d. 16p. Order from LC. Mi $2.40, ph $3.30. WAPD-TH-381

"Preliminary vertical upflow boiling pressure drop data for water in a 0.050 in x 2.25 in. x 72 in. long rectangular channel at 200 psia." Westinghouse Electric Corp. Pittsburgh, Pa. n.d. 15p. Order from LC. Mi $2.40, ph $3.30. WAPD-TH-385

## Stable Isotope Separation

Thermal behavior of countercurrent equipment, by Harold L. Hull and Herbert A. Pohl. E. I. du Pont de Nemours & Co. Explosives Dept. - Atomic Energy Div., Technical Div. - Wilmington, Del., Dec 1954. Decl. Mar 1957. Contract AT(07-2)-1. 77p. Order from OTS. $2.00. DP-97

Production of heavy water Savannah River and Dana Plants. Technical manual, by W. P. Bebbington and others. E. I. du Pont de Nemours & Co. Explosives Dept. - Atomic Energy Div., Technical Div. - Savannah River Lab., Aiken, S. C. Jul 1959. Contract AT (07-2)-1. 163p. Order from OTS. $3.00. DP-400

Dana Plant monthly reports for May 1952 through November 1952. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Oct 1952. 34p. Order from LC. Mi $3.00, ph $6.30. TID-5330(Rpt. 6)(Del.)

Dana Plant monthly reports for December 1952 throught December 1953. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Dec 1953. 16p. Order from LC. Mi $2.40, ph $3.30. TID-5332(Rpt. 5)(Del.)

Dana Plant monthly reports for December 1952 through December 1953. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Oct 1953. 20p. Order from LC. Mi $2.40, ph $3.30. TID-5332(Rpt. 11)(Del.)

Dana Plant monthly reports for December 1952 through December 1953. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Indiana. Nov 1953. 18p. Order from LC. Mi $2.40, ph $3.30. TID-5332(Rpt. 12)(Del.)

Dana Plant, technical department. Monthly status reports for January 1954 through December 1954. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Jan 1954. 16p. Order from LC. Mi $2.40, ph $3.30. TID-5334(Rpt. 1)(Del.)

Dana Plant, technical department. Monthly status reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Jan 1955. 15p. Order from LC. Mi $2.40, ph $3.30. TID-5338(Rpt. 1)(Del.)

Dana Plant, technical department. Monthly status reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Feb 1955. 13p. Order from LC. Mi $2.40, ph $3.30. TID-5338(Rpt. 2)(Del.)

Dana Plant, technical deptartment. Monthly status reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Mar 1955. 17p. Order from LC. Mi $2.40, ph $3.30. TID-5338(Rpt. 3)(Del.)

Dana Plant, technical department. Monthly status reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. Apr 1955. 15p. Order from LC. Mi $2.40, ph $3.30. TID-5338(Rpt. 4)(Del.)

Dana Plant, technical department. Monthly status reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Atomic Energy Div., Terre Haute, Ind. May 1955. 17p. Order from LC. Mi $2.40, ph $3.30. TID-5338(Rpt. 5)(Del.)

Heavy water technology section monthly progress reports for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Savannah River Lab., Augusta, Ga. May 1956. 16p. Order from LC. Mi $2.40, ph $3.30. TID-5339(Rpt. 5)(Del.)

Heavy water technology section monthly progress report for January 1955 through December 1955. E. I. du Pont de Nemours & Co. Savannah River Lab., Augusta, Ga. Oct 1956. 19p. Order from LC. Mi $2.40, ph $3.30. TID-5339(Rpt. 10)(Del.)

## Technology—Feed Materials

Process development quarterly report. Part II. Pilot Plant work, by J. U. Shepardson and J. A. Nelson. Mallinckrodt Chemical Works. St. Louis, Missouri. Aug 1959. 72p. Order from OTS. $2.25. MCW-1431

Topical report. A process for controlling insoluble uranium in ore concentrates. III. Plant operation, by W. S. Knecht and L. R. Lollrah Mallinckrodt Chemical Works. Uranium Div., St. Louis, Missouri. Jul 1959. 26p. Order from OTS. $1.00. MCW-1432

Production of porous pellets of hydrated orange oxide, by Paul W. Henline and others. National Lead Company of Ohio. Cincinnati, Ohio. Jul 1957. Contract AT(30-1)-1156. 50p. Order from OTS. $1.75. NLCO-718

Investigation of hydrometallurgical system acid leaching media, by Alvin B. Kreuzmann. National Lead Company of Ohio. Cincinnati, Ohio. Oct 1958. Contract AT(30-1)-1156. 24p. Order from OTS. $1.00. NLCO-781

Development of a process for nitric acid digestion of Belgian Congo pitchblende, by William C. Manser and others. National Lead Company of Ohio. Cincinnati, Ohio. Nov 1958. Contract AT(30-1)-1156. 22p. Order from OTS. $1.00. NLCO-782

Fuel breeding. A literature search, by James M. Jacobs. Technical Information Service Extension, AEC. Oak Ridge, Tenn. Aug 1959. 72p. Order from OTS. $2.00. TID-3534

## Technology—Raw Materials

Recovery of thorium, uranium, and rare earths from monazite sulfate liquors by the amine extraction (AMEX) process, by D. J. Crouse and K. B. Brown. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 63p. Order from OTS. $1.75. ORNL-2720

An isopiestic investigation of DI (2-ethylhexyl) - phosphoric acid and tri-n-octylphosphine oxide in n-octane, by C. F. Baes, Jr. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 16p. Order from OTS. 75 cents. ORNL-2737

Solvent extraction of uranium from reduction slag slurry, by A. D. Ryon and F. L. Daley. Oak Ridge National Lab. Oak Ridge, Tenn. n.d. Contract W-7405-eng-26. 19p. Order from OTS. 75 cents. ORNL-2744